METHODS AND RESULTS OF TESTING SCHOOL CHILDREN

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MANUAL OF TESTS

USED BY THE PSYCHOLOGICAL SURVEY IN THE PUBLIC SCHOOLS OF NEW YORK CITY

INCLUDING SOCIAL AND PHYSICAL STUDIES OF THE CHILDREN TESTED

BY

EVELYN DEWEY
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ERRATA

Make the following corrections before using the tables.

Page 77. Table 1. Girls, Age 9, S.D.: *Read* .191 *for* 1.91.
80. Table 8. Boys, Regression equation: *Read* + *for* ±.
87. Table 32. Boys, Age 11: *Read* ±.11 *for* ± 11.
92. Table 41. Boys, Age 13: *Read* ±.56 *for* ±.69.
95. *For* Problem B *read* Problem Box.
110. *For* Balland Field *read* Ball and Field.
117. Maturity Scale, Boys, T_6: *Read* −.021 *for* +.021.
117. Maturity Scale, Boys, T_7: *Read* +.115 *for* +.062.

NEW YORK
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REPLACING
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ACKNOWLEDGMENTS

THE idea of this survey was conceived by Lucy Sprague Mitchell who has given her constant cooperation in the development of the plan. We are indebted also to William E. Grady, through whose efforts the Psychological Survey was granted permission by the Board of Education to work in the New York Public Schools, to Margaret E. Knox for her active cooperation through two years of testing in her school, to Eleanor Hope Johnson for her services as secretary and business manager and to the principals and teachers of the schools in which we worked for their courtesy and helpful assistance.

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INTRODUCTION

PERMISSION was granted to the Psychological Survey by the Board of Education to conduct an investigation in the New York City Public Schools in February, 1915. The immediate purpose of the investigation was to obtain norms for a series of tests for New York public school children in the poorer and more congested portions of the city, as a basis for further study of the value of mental tests for improved school room procedure.

It was hoped that the results would justify the establishment of a school clinic for normal children to assist the teacher in meeting the problems of individual pupils. Psychological tests had been used as the basis for giving immediate suggestions to the teacher for the treatment of a group of children in Public School 15 who had been unable to adjust to the usual class-room procedure. The work led to the belief that the diagnosis made from the analysis of a reliable series of tests would be of practical value to the teacher in dealing with puzzling children. As a preliminary to the establishment of such a clinic it was necessary to develop a series of tests which would be applicable to the type of problems presented in the schools, and to obtain norms for large groups of children.

Helen T. Woolley of the Bureau of Vocational Guidance in Cincinnati spent a month in New York organizing the staff and launching the work; the direction was then undertaken by Professor J. W. Hayes, at that time assistant professor of psychology in the University of Chicago. Miss

Evelyn Dewey has directed the work since 1918. The data for the social and physical study were gathered and tabulated under the direction of Miss Harriet Forbes, of the Bureau of Educational Experiments of New York City.

The staff which is responsible for this report consists of Evelyn Dewey, director; Emily Child who has had charge of the presentation of the social and physical material; Beardsley Ruml, statistician; Louise Schriefer and Lois Treadwell Ruml, assistant statisticians.

Others who have served upon the staff at various times since the work started are: Elizabeth Irwin, Harriet M. Johnson, Lucy Sprague Mitchell and Georgie J. Ruger (testers); Edith Day and Helen Gregory (home investigators); Dr. H. L. Barnes and Dr. Nancy Jenison (examining physicians); Frederick W. Ellis (special study, 1917-18).

This volume furnishes a guide for workers who may wish to use the methods employed here, for clinical work or for further investigation. The tests, with their instructions and norms, the Maturity Scale with an explanation of its meaning and use, and a summary of the social and physical studies are presented. A further publication will deal with the possibilities of interpreting the objective data of mental tests. An analysis will be made of relationships found for the physical, school and test measures, from the point of view of the practical problems presented by school children.

PART I

MENTAL TESTS

CHAPTER I

PROBLEMS AND METHODS

The tests used in this investigation and the methods employed were chosen in order to throw light upon some of the preliminary problems involved in the establishment of a psychological clinic for normal children. The staff was of the opinion that such a laboratory could not be of general use in the public school situation until information about mental tests was considerably increased by research. We wished to find out the extent to which objective test results can be of help in the analysis and improvement of the individual child's adjustment to school. In order to answer this question, investigation along two lines is necessary. First, tests with a demonstrable relevancy to the problem must be assembled into a working unit and standardized. Second, the meaning of the results of these tests must be established by equally objective methods. This report presents the material accumulated in the course of the investigation, which has a bearing on the first phase of the problem.

We believed that mental tests could furnish a technique for individual analysis which would throw light upon the pupils' adjustment to the school and upon the adequacy of school measures for describing the child. If tests are to be used as a basis for making changes either in the environment of the individual or in school methods it is imperative to distinguish between two methods of using tests. In the clinic which is directed by a psychiatrist or a psychologist with a strong interest in the problems of abnormal psy-

chology, mental tests have come to be used as a guide for the examiner. They are one of the many tools which he uses in his observation of an individual for the detection of abnormalities. The way in which he uses tests and the interpretation which he puts upon a subject's reactions are largely determined by his particular classification of psychological knowledge and his point of view on psychiatrical problems. "This method throws the responsibility for the final diagnosis on the experimenter." * It is the method which has been chiefly used in the past even in clinics with a similar aim to that suggested for the outcome of this investigation. But we believe that if such clinics are ever to become general, and if mental tests are as valuable an instrument as seems to be indicated at present, their use from another angle must be developed. We wish to discover if an individual analysis can be made *by* the tests, not *from* them; an analysis which is definitely the outcome of purely objective test results.

Therefore the methods frequently employed in clinical procedure were not available for our purpose. Much information valuable for diagnosis can undoubtedly be obtained simply by observation of the subject's behavior and method of attack during a test, but a large part of it is directly dependent on the judgment and skill of the examiner and is to a very limited extent capable of actual practical uniformity of procedure from examiner to examiner, from time to time, and from one situation to another. Even though there were a psychologist dealing with the problem of the sub-normal and mal-adjusted children in every school it still would do little to advance our knowledge of the use and value of tests if each followed his own methods and altered the procedure to meet every shifting situation. Instead, what is needed is a uniform method of administration, so that the results can be considered as a

* Brigham, C. C. Two Studies in Mental Tests. Psychol. Mono., 1917, xxiv, No. 1.

measure of the reaction to a situation which can be relied upon as practically constant. By a rigid adherence to this method progress will be made in discovering what mental tests measure and to what extent they afford a safe basis for making practical suggestions concerning the individual. Standardization and its corollary, quantitative measures, were, we felt, not only necessitated by the practical situation which we had to meet but were in themselves the most fruitful line of investigation.

Such investigations alone will determine whether mental tests can describe and analyze an individual or are merely a device for furnishing the expert diagnostician with concentrated material for observation. Meanwhile the practical application of test results should be made in a tentative spirit.

Since no meanings were to be read into the tests which did not come from the results, the data had to be in such shape as to lend themselves to investigation. The tests had to be arranged to measure, in numerical form, fine differences of performance between normal children of the same age. Before the meaning of these measures in individual terms could be investigated, it was necessary to discover how children in general react to the tests. It is impossible to say that a pupil differs by so much or in such and such particulars from his fellows until we know in terms of the test series what an average pupil is. Therefore the test results must be given to large enough groups of children to insure reliable norms.

But if we are to be consistent in our point of view that the interpretative machinery is within the test we are not ready to make a practical use of the results when the tests are defined and norms established. The significance of the results for the problems to be ultimately attacked must still be found by an objective method. Since there has never developed a satisfactory criterion of what degree and type of adjustment should be demanded of every child, or of just

what education should accomplish, it would not be wise to measure the test results by arbitrary standards for these things. Meanings must be looked for by checking the tests against every available criterion which can be expressed in sufficiently simple and concrete form to insure general agreement as to its legitimacy. This study of relationships must be made on the group results as the only available method of insuring both the general relevancy and the objectivity of the conclusions. When the definite meaning of the results has been established by the test relationships, it is time to draw conclusions as to the practical use that can be made of the tests. Here again the psychological and social point of view of the worker comes into prominence. The significance of any one of the known facts about a test for the individual problem is a complex affair which will be somewhat determined by the personality, experience and interests of the person dealing with the problem.

In assembling the tests and adopting methods for their study we have attempted as far as possible to keep ourselves free from theories and preconceptions. Our aim has been to gather as much reliable data about our subjects as possible and then to study their interrelations and relevancy to school problems with the best methods at our command.

The value of such data, however, largely depends upon their completeness. It would not be safe to make an analysis of an individual's reactions to a series of test situations if the external factors which might be conditioning these reactions were ignored. In working with a maladjusted school child, it is obvious that home conditions and physical development are forces which may prove of equal importance with the mental constitution of the child in explaining his relations to the school. Therefore a social and physical measure seemed necessary. We believed that in order to develop these measures an exhaustive description of the physical development and condition and the social status of the children was needed. The conditions under which we

were working seemed to offer an excellent opportunity to study the usefulness of such exhaustive descriptions.

In the choice of tests for the mental examination we kept the same aim in mind, that of obtaining a detailed picture. In attempting to do this, however, we felt it very undesirable to plan our outline on the basis of a preconceived belief as to just what mental processes, in conventional psychological terms, should be included and we avoided any implication that we were testing precise and exactly delimited mental processes; at this moment "memory," at another "attention," or "constructiveness" or "visual discrimination." The range of processes which make up an individual's mental equipment has not as yet been determined. The so-called higher mental processes are capable of analysis in so many different terms that it becomes obvious that they are themselves a generalization rather than a measurable entity. As soon as the attempt is made to make constructiveness, for instance, concrete in a test situation, we find that memory and attention are also involved. This is true of any arrangement of processes that may be selected. Even in tests where the situation is kept fairly simple like those for rote memory or muscular adjustment, our measure of the individual's possession of the quality is entirely in terms of his reactions to a particular situation. A rote memory test does not give a cross section of the individual's inherent and generalized ability to remember by rote. It indicates only the way he remembers digits or syllables under certain conditions. But so far from being a limitation of the test method for a problem such as ours this seems to be one of its chief advantages. An analysis of the pupil's adjustment to school demands can be useful only if it is made in terms that are common to the situations of everyday life. Therefore if the tests are arranged to present a varied and definite group of activities requiring types of adjustment like those the child is called upon to make in daily life, they should furnish a valuable

comment upon the reaction of the child to his environment.

We definitely assumed that test situations could be employed, each one of which would involve mental factors, and the belief was implicit that the more varied the situations adopted the more likely would we be to cover a rather broad range of mental adjustments. This did not, however, involve any attempt to prescribe or judge the proportion of various phases of mental activity involved. The school marks and school history furnish records of the adjustments to situations which are sufficiently defined by the curriculum and by the administrative methods of the school to make them available as measures. Therefore we felt that tests which presented the same type of situation as school work should be included in the series only where it seemed desirable to get measures of simpler situations than those represented by marks and school progress. Aside from this, our aim in adding to the test series was the purely general one of presenting situations requiring mental adjustments of the type that a child uses in accommodating himself to his world.

As the investigation proceeded we became aware that certain types of situation had been omitted which might have added distinctly new elements to the test series. It was equally apparent that certain tests did not vary the type of adjustment. In spite of the fact that at practically every stage of the investigation improvements could have been made, we limited our changes almost wholly to the elimination of tests that were unsatisfactory in some phase of administration. This procedure was prescribed by the fact that we were examining successively children of six different ages and changes would have necessitated the repetition of the test or tests involved for the ages already examined.

In developing methods for evaluating test results, the worker is likely to discard qualitative measures reluctantly. We all tend to assume that the terms in which we are

accustomed to measure values are the best standard that can be applied. But when we examine closely the variable elements in such a score as "good—neatly but rather slowly done," we realize that although it has a satisfying sound, it is in reality extremely vague when compared with the statement that a child scored 7 on a range of scores from 0 to 12 covering the performances of a representative group. What appears good to one examiner may not to another. Even when uniform instructions are followed, we cannot be sure just what it was in the test that was good; the result, the method followed by the subject, or his attitude toward the task. Nor can an examiner always be sure that only elements which he considered significant in the test are influencing his judgment. The human tendency to make allowances for such factors as youth, bad physical condition, obviously poor home opportunities, is extremely difficult to control in making qualitative judgments, with the result that the same examiner might rank the same performance very differently under different circumstances.

The attempt to get qualitative factors of a test in terms that are comparable for all subjects is especially difficult where standard results are desirable. If it is made conscientiously the time involved is very great. Long experimentation is necessary before values can be assigned to different types of performances. The problem of identifying each performance as of one type or another persists as long as the test is used. The attempt to define a standard capable of use by other examiners tends to result in elaboration which finally becomes meaningless. The score 7, however, represents a concrete result in the form of errors, time, number of moves or number of successes. Given carefully trained investigators, who make records that are capable of re-evaluation, the score will always represent approximately the same performance. The obvious difficulty of this method, i.e., that of making sure that the

element of the test chosen for measurement is significant, is not greater than when a qualitative method is pursued.

In order to secure the best quantitative measures of our tests the fullest possible records were made of the details of the subject's performance. These records made a large number of values available for final treatment. From these values, we have attempted to select those which represented the significant elements of the test and lent themselves to statistical treatment. Furthermore, values had to be in such terms that a serial ranking of normal children of the same age would result. In a few instances we were unable to get a single value for the test and in others we had to ignore some obviously valuable factors; either because they had not been recognized when the test was standardized or because they proved incapable of statistical arrangement.

Having eliminated the unknown factors which are present when individual judgments are relied upon for giving and interpreting tests it is possible to assume that within certain limits the results for a test will be comparable. There are however, certain factors which it is impossible to control absolutely and the judgment of the examiner must be relied upon in determining their influence upon the subject's reactions. It is clear that certain external conditions would inevitably change during the course of an intensive investigation such as ours. Children were tested in half a dozen schools and with as many different kinds of working space and conditions. Several different examiners were at work and their places might be taken by others before the work was completed. The effect of the personality of the examiner, the momentary emotional condition of the subject, the workroom, different hours of the day, etc., cannot be absolutely controlled. But by prescribing a definite procedure for the conduct of the examination and of each test, by providing for the commoner emergencies presented by the children, and by training the examiners as a group so that uniformity is assured for instructions,

attitude and manner, a great many variables are eliminated.

The methodological problem that must be met in undertaking such an investigation as the present one is the extent to which standardization shall be carried and the amount of initiative and judgment that shall consciously be allowed the examiners. We chose to adopt a method in which the maximum of rigidity and uniformity were prescribed, under the conviction that a really quantitative measure of the child's adjustment was our goal and would justify the limitations in flexibility which it would necessitate.

It is obvious that such measures can be obtained only from records made by individual testing. Although the time involved in testing by this method is very great it seemed the only legitimate one to pursue in an investigation of tests. Group testing imposes limitations on the type and form of test material. It also makes it impossible to insure the maximum of effort on the part of each subject or the tester's observation of individual situations which may practically invalidate the test. It seemed especially important, in selecting test situations as we did, that we should be free to include any test which seemed to give a picture of the adjustments we were studying. Although the group method permits of a wider and less specialized use of tests, it is too wasteful and too limiting a method to employ for research. It is also a question whether in the present stage of test knowledge it can yield sufficiently complete pictures for individual analysis.

Some form of arrangement of the material is necessary to describe the results. Even such a simple thing as excellence in a test is not always observable from the child's score. This we felt was primarily the task of a statistician; while that of the examiners was to get a sufficiently large body of results to make statistical treatment fruitful, and to control, as far as possible, the external factors which might cloud the psychological significance of the results.

CHAPTER II

GENERAL PROCEDURE

Selection of Subjects

The selection of subjects is a vital question in planning an investigation since the value of the results depends upon the definiteness with which the group can be described. Our interest was in the public school children of New York City. But this population consists of children whose every characteristic varies. Therefore some further selection within the group was necessary. Since so many of the children who attend the schools come from families that are comparatively recent arrivals in this country, we felt that the value of the work was not compromised by selecting a foreign group. It was also necessary to do so if any control was to be exercised over nationality. The only schools in the city where markedly homogeneous conditions of race and social status exist are those in the foreign quarters. Fortunately the principals who were most interested in cooperating in the work had schools where the social homogeneity was very marked and where the majority of the pupils were of one race—Jewish. We therefore decided to base the investigation upon results obtained from Jewish subjects, and to collect a parallel body of results in schools where other nationalities predominated. This we hoped would bring out the extent to which our conclusions and interpretations were applicable to city school children in general.

The practical difficulties of testing groups of different social and economic levels in the New York Public Schools

GRADE DISTRIBUTION OF TEST GROUPS

Boys

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
I A						
I B	2					
II A	5	1				
II B	12	2				
III A	17	3	1			
III B	11	11	3	2		
IV B	3	19	4			
IV B	..	12	6	5	3	
V A	..	2	12	10	7	
V B	..	..	16	9	6	
VI A	..	..	6	11	7	5
VI B	..	..	2	13	9	8
VII A	..	..	..	..	10	7
VII B	..	..	..	..	3	17
VIII A	..	..	..	..	2	8
VIII B	..	..	..	..	3	5
Mean Grade*	3A.7	4A.2	5A.7	5B.7	6B.2	7B.0

* The means which accompany this table were reckoned on the basis of the exact place in the grade that each child had reached at the time of being tested. A numerical value was assigned to each grade so that the values ranged from 1 for I A to 16 for VIII B and the fraction of the grade through which the child had progressed according to the days, weeks or months spent in it was represented as a decimal.

Girls

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
I A						
I B						
II A	6					
II B	10	3				
III A	21	3	2			
III B	13	11	6	2		
IV A	..	23	5	1	1	
IV B	..	10	11	3	4	
V A	..	..	13	4	3	
V B	..	..	11	8	2	
VI A	..	..	2	17	12	3
VI B	..	..	..	12	2	8
VII A	..	..	..	3	12	8
VII B	..	..	..	..	10	5
VIII A	..	..	..	..	3	19
VIII B	..	..	..	..	1	7
Mean Grade	3A.7	4A.2	5A.1	6A.0	6B.5	7B.4

are so great that it was decided not to attempt a check of this sort. The other racial groups were selected from schools where the environment of the pupils approximated that of the Jewish children as nearly as possible.

In working with children it is obvious that the problem of measuring differences between individuals is complicated by the age factor. We expect children of different ages to do things differently even if their general ability is equal. Therefore results had to be obtained for children of different ages. By testing equal numbers of similarly selected children through a series of years it is possible to measure the effect of growth on the test performance. One year was chosen as a convenient and usual dividing point for age. All the age groups contained the same number of subjects in order to facilitate handling the results. Equal numbers of boys and girls were included in the age groups, not because we had any theories about sex differences, but because if differences in performance did exist we wished to be able to treat the groups separately.

Pupils below eight years could not be tested because some knowledge of reading was necessary and thirteen years was chosen as the upper limit because it roughly marks the age when chilren leave elementary school.

Having determined from the outset to base interpretations only upon an objective handling of the material, it was necessary to have groups which were suitable for statistical treatment. One sex of one age was taken as the natural unit for treatment. Fifty was the number decided upon for each unit. Larger groups would undoubtedly simplify much of the work of interpretation, but fifty seemed a sufficiently large number of cases on which to base conclusions about such homogeneous groups, and the time necessary for testing was so great that it seemed impossible to increase the groups appreciably.

The Jewish subjects who make up the bulk of those tested were pupils in Public School 15 on East Fifth Street,

a school of over 3000 pupils, ninety-five percent of whom are Jewish. The boys are transferred from this school to Public School 64 for the seventh and eighth grades so that the twelve and thirteen year old boys were tested there. The test groups were made up by listing all the Jewish boys and girls of eight through thirteen years separately. Each list was then divided into five lists, by grouping all the children who had passed their eighth birthday and not yet reached their ninth, etc., for each age. Fifty subjects were then selected from each list distributed through the grades proportionately to the actual representation of children of that age in each school grade. This was accomplished by determining the percent of the whole age group found in each grade, and planning the age-sex groups upon the same basis. Thus a true cross section of the school population for each age studied was obtained. Aside from this proportional representation, the only control exercised in making up the groups was the elimination of children who did not belong to the racial group, and of children in the classes for mental defectives or those recommended for admission to these classes.

Public Schools 19; 82 and 76; 41 and 16 contained a large majority of Italian, Bohemian, and third-generation American children respectively. These schools were chosen for testing for the racial check. Because of the limited time the tests were given to only 125 children in each of the three racial groups. These cases were selected in the same way as the Jewish. The age groups are therefore too small to be presented as norms and the results are omitted from this study.

Selection of Tests

The original plan of the work was to obtain norms for children from eight through thirteen years of age, for tests that had been in use in the Child Labor Division of the

Bureau of Vocational Guidance in Cincinnati, for children of thirteen to eighteen years of age.

The tests were: *

Strength of Grip, (Whipple No. 6)
Steadiness of Motor Control, (Whipple No. 13)
Tapping—quickness of movement, (Whipple No. 10)
Rote Memory, (Whipple No. 38)
Completion of Sentences, (Whipple No. 46B)
Cancellation of A's, (Whipple No. 26)
Association by Opposites, (Whipple No. 34C)
Substitution, (Whipple No. 37C)
Card Sorting, (Jastrow)

In order to present objective situations requiring as varied a range of mental adjustments as possible, other tests were added to the series. These were Healy's Construction puzzles A and B and Picture Completion, Terman's Ball and Field problem, Rossolimo's† card punching test for attention, the Hayes Learning and Problem Boxes, the Ellis Memory for Objects Test, the Knox Cube Test, and a test for the identification of forms. The Binet-Simon Age Scale and the Yerkes Point Scale were included in the series in order to make a study of their comparative value, and of the value of the age-scale method of grading compared with a varied series of tests.

These tests were given to a preliminary group of children in Public School 15 in order to determine their suitability for our subjects. During the time that the first group of eight year old children were being examined, other tests which varied still further the type of situation presented to the subjects were developed. These were:

* Whipple, G. M., Manual of Mental and Physical Tests, Parts I and II. Woolley and Fischer, Mental and Physical Measurements of Working Children. Psychological Monographs, Vol. XVIII, No. 1.

† Rossolimo, Die Psychologischen Profile. Klinik für Psychische und Nervöse Krankheiten, VI Band, 3 Heft.

Nail Driving	Cart Construction
Needle Threading	Narrative Pictures
Fastening Buttons	Instruction Box

The Problem Box was found to be too difficult for the eight year old children and its use was postponed until the testing of the other age groups. Before the examination of the nine year group, the tapping and sentence completion tests were dropped from the series and certain minor changes were made in the instructions for other tests. The tapping test was discarded since it was impossible to adjust the electric enumerator to record accurately and the limitations of time and space made the use of the kymograph impractical. It proved impossible to develop an adequate objective standard for evaluating the sentence completion test and, rather than introduce the uncertainty of individual judgments into the scoring, the test was given up.

For the uniform examination of all subjects from nine through thirteen years, the tests were divided into five series as follows:

Series A	*Series B*
Picture Completion	Memory for Objects
Healy A	Healy B
Identification of Forms	Memory for Digits
Opposites	Card Sorting
Cancellation	Substitution

Series C	*Series D*
Cart Construction	Narrative Pictures
Rossolimo	Instruction Box
Ball and Field	Steadiness
Nail Driving	Learning Box
Needle Threading	Strength
Problem Box	

Series E

Binet-Yerkes
Knox Cubes

The instructions followed in giving Opposites, Learning Box, Rossolimo's test and Buttons are not included in the section dealing with the instructions for giving and scoring tests since the results had to be discarded because of various imperfections. In the case of Opposites, we followed the method of many other testers, using several lists in order to prevent coaching. These lists were first judged approximately equal by inspection, but when the lists were actually compared on the basis of the subjects' responses, they proved to be so different in difficulty that the test had to be omitted. The Learning Box proved so puzzling to many children that they were unable to open it on the first trial without help. This resulted in variations of the instructions which made it seem unwise to use the results. The button test was given up because of difficulty in keeping the materials standard. Rossolimo's test was omitted because of uncertainties which arose in evaluating the errors.

Testing Procedure

The tests were given to the children individually and under standard conditions. An effort was made to avoid the child's receiving the impression that he was being classified according to his performance in the tests or that he was undergoing a school examination. The testing was never begun until the child felt at home with the tester and interested in doing as he was asked. His mistakes were never corrected, the tester maintaining an encouraging and satisfied manner no matter what the response.

The examiners memorized the instructions and then practiced with trial subjects until they could give the instructions verbatim, handle the material easily and meet all the common emergencies presented by the children. Twice during the school year each tester rehearsed the instructions in the presence of another to prevent deviations from the standard.

It was impossible to give each worker a complete set of

test material. This necessitated adjustments which made it impossible to start the examination of every child with the same series of tests, or complete it in the same order. Therefore twenty-five percent of each age group were given Series A at their first examination, twenty-five percent Series B, etc. Series E was always given at the fourth or fifth examination. Within each series the tests were given in the order listed.

Each examination lasted from twenty-five to forty-five minutes. If a subject had not finished the series within the longer time he was sent back to his class-room and the testing finished at a sixth examination. It was found impossible to regulate the period which elapsed between examinations, but most of the cases were finished in a period of two or three weeks. Exceptional cases were crowded into a week or spread over a month, rarely more.

The records called for in the instructions were made by the tester on printed blanks as the subject responded. No scoring was done while the tests were being given. The tests were scored on the original blanks by one person except where the rules were complicated when they were rescored by a second person. In timing responses "football-timer" stop-watches were used. They were found easier to handle and not subject to the constant breakage of the ordinary stop-watch.

The subjects were numbered and the numbers instead of the names used in all work on the material. As the scoring was completed the detailed results were entered on large sheets, which were made up for each test group, a test group consisting of one sex of one age for each nationality. The original blanks were preserved and filed by number. They have been found invaluable for reference and without them much of the work of developing the best test values would have been impossible. The work of compiling norms was done from the big sheets. The more elaborate statistical work was done from case cards made from these sheets.

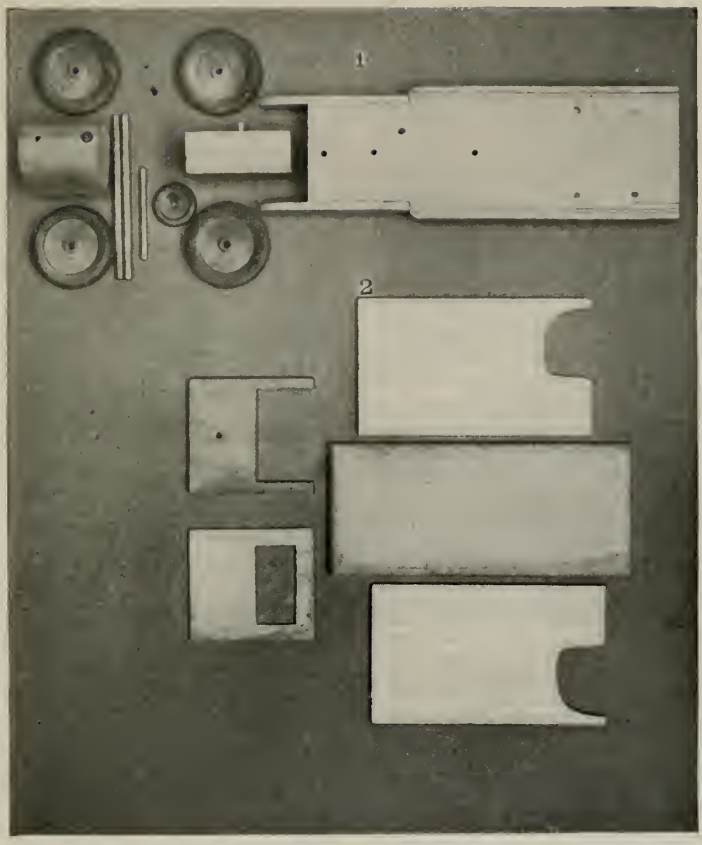
CHAPTER III

INSTRUCTIONS FOR GIVING AND SCORING THE TESTS

The instructions which we have used in administering, recording, and scoring the tests are given in detail, with a description of the material for tests which we have devised. No attempt has been made to present an analysis of the tests or of their results in this volume. We have included only those tests where we found the results capable of use either for age norms, statistical analysis, or individual description.

In deciding upon the norm values we chose those scores which seemed the most complete numerical representation of a total performance or a definite phase of it. The best single value for ranking the subjects was selected from the norms, for statistical analysis. Many other reactions which we considered worth noting as presenting a picture of the individual performance were recorded in a uniform manner. The complete records were summarized and studied before choosing the norms.

Wherever verbatim instructions are available for giving tests which have been used by other investigators, those instructions have been followed, with only such changes and amplifications as were necessary to insure a uniform procedure and the understanding of the directions by our subjects. It was our plan to score the tests of other investigators as they have, so that comparisons could be made, but because of the necessity for arranging a single value for each test it was impossible to do so in most cases. The



Figs. 1 and 2.—Cart Construction Test.

changes in scoring and evaluating which we have introduced are discussed in the notes on each test which follow the instructions.

Cart Construction (Hayes-Dewey)

Materials: Schoenhut's "cart model No. 10," a wooden toy automobile. Stop-watch. The four side pieces of the model with the holes through which the axles slip were glued fast to the body, so that there were sixteen pieces in the cart. Care should be taken to have all the pieces fit accurately and not too tightly in a new model. The models should be replaced by new ones from time to time as long use results in a loosening of the parts and a tendency for them to fall apart even after being properly adjusted.

Instructions: Present pieces for body of auto as shown in cut. Say, "I want you to see if you can put all these pieces together so that they will make an automobile. You see this (show chassis) is part of an automobile and here are all the pieces you will need to finish it. Now see how quickly you can make it so that it will stay together and will run." Start watch as instructions are finished. Stop it when all the pieces are in place, or when the subject insists he can do no more, or when the time limit of eight minutes is reached.

For second part of test, make any corrections necessary to perfect body of auto and present pieces for the top in the manner shown in cut No. 2. "You see these other pieces. If you put them on the automobile just right, they will make a top for it and turn it into a delivery wagon. Now see how quickly you can put them on." Start watch as instructions are finished. If no start has been made (no pieces of the top are attached to the body or to each other) at the end of two minutes, end the test. If any start has been made allow eight minutes to complete it if necessary. Take time as for first part.

Record: Record the time in seconds separately for Parts I and II. Record the subject's procedure as follows:

PART I

Performance	Symbol.
Putting axles on cart	X and Y
Putting wheels on axles	A, B, C, D
Putting steering wheel on post	E
Putting seat on cart	1
Putting engine on cart	2
Putting steering post on cart	3

PART II

Putting sides on	5a, 5b
Putting back on	6
Putting top on	7
Putting wind shield on	4

The removal of a piece is recorded by the symbol followed by x. A piece incorrectly attached to the body is recorded by an o after the symbol. A piece laid on the body or propped against it is recorded by drawing a line through the symbol. Record each move made by the subject.

Evaluation: Give a credit of two points for each part correctly attached to the body and one point for each part incorrectly attached. Perfect performance for Part I, 20 points, for Part II, 10 points. A correct or incorrect relation of parts *off* the cart receives no credit except (1) the fastening of wheels on axles and the balancing of cart on these without proper attachment of axles to cart. Here give one point for each wheel, nothing for the axles. (2) Putting both axles through front or rear axle holes, one on each side of cart, and putting a wheel on outside end of each axle. Here give one point for each wheel, nothing for the axle. We give as norms the time in seconds for Part I and the

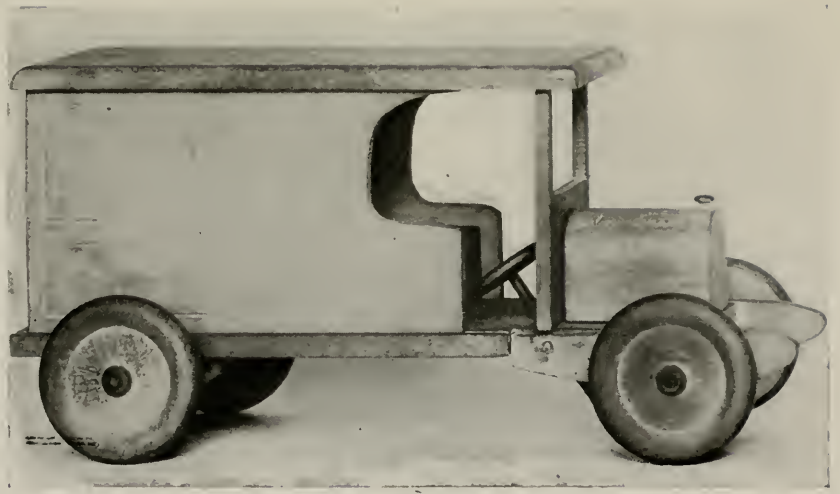


Fig. 3.—Cart Model.

total score for Parts I and II; both values were also used for analysis.

Notes. This test was devised to meet the suggestion of some of the teachers interested in the investigation that tests making use of concrete material in familiar form should be useful for an examination of educational methods. Since we wished to keep the number of performance tests* as large as possible, we decided to include the making of a familar object from materials where manual skill would play as small a part as possible. The cart model seemed to meet these conditions as the material is so simple that it seems fair to say that the test is one involving definite constructive or creative activity, rather than mechanical ability.

With the group of children we were testing, toys of this sort are unknown. Each child was asked if he were familiar with the auto or other toys like it. With the exception of two children in the American group, the few affirmative answers all proved to be due to a misunderstanding. But with children of a higher economic status the usefulness of the test would probably be seriously limited by the subjects' familiarity with similar material.

Narrative Pictures (Hayes-Dewey)

Materials: Cinderella "Stampcraft" book, and the twelve poster stamps illustrating the story, mounted on cardboard. Stop-watch. The twelve pictures are mounted in two rows on a 9 by 17 inch white cardboard in the following order, the numbers referring to the order in which the pictures belong in the book: upper row, from left to right, 6, 10, 2, 12, 8, 7; lower row, 1, 7, 3, 9, 5, 11. The text of the book is rearranged so that there are two superfluous pictures on the card. Pages one and two are com-

*For description of a test with a similar purpose see Kelley, T. L., A Construction Ability Test. Journal of Educational Psychology, January, 1916.

bined so that picture No 2 is correct and pages 10 and 11 so that No 11 is correct. The text as we used it follows. Part 1, picture No. 3 on the card:

Once there was a little girl named Cinderella, whose father took for his second wife the most proud and haughty woman ever seen. She had two daughters who were just like her.

The stepmother and stepsisters were very unkind to the little girl, because she was so good and beautiful. They made her do all the meanest work about the house; she it was who washed the dishes and scrubbed the floors.

One day, the King's son was to give a grand ball. Of course the proud sisters were invited, but nobody thought of taking little Cinderella.

The two sisters were delighted. Cinderella gladly helped them dress, and even offered to arrange their hair.

While she was dressing their hair, her sisters said to her, "Cinderella, don't you wish you could go to the ball?"

"You are only making fun of me," said Cinderella. "How could I go to the grand ball as I am?"

"You are right," they said, "people would laugh at such a dirty cinder-maid as you."

Part 2, picture No. 9:

At last the stepsisters and their mother left for the ball, and poor Cinderella was left all alone. She was so unhappy because she could not go to the ball that she sat down and began to cry.

Suddenly, Cinderella's Godmother appeared before her.

"Why are you crying?" asked her Godmother.

Fig. 4.—Narrative Pictures.

"I want—oh, I want——" sobbed Cinderella without being able to say another word.

"You want to go to the ball?" said her Godmother. "Well then if you wish very much to go and will do just as I tell you, I'll see that you are soon there. Now dry your tears."

Part 3, picture No. 6:

"First of all," said her Godmother, "you must run into the garden and bring me the largest pumpkin you can find."

Cinderella did not know what her Godmother could possibly want with a pumpkin, but she did as she was told. Her Godmother scooped out the inside and touched it with her wand. Instantly the pumpkin was changed into a beautiful gilded coach.

"Now I want a mouse-trap," said her Godmother.

Away ran Cinderella, who soon returned with a mouse-trap with six mice in it. Cinderella opened the door of the mouse-trap and, as the mice ran out, her Godmother changed them with her wand into six prancing horses."

Part 4, picture No. 11:

"Now we have your coach and horses," said her Godmother, "but what shall we do for a coachman? Run and bring me the rat-trap."

Cinderella brought the trap and in it were three big rats. The Godmother chose the biggest of the three, and, having touched him with her wand, he was changed into a fat, jolly coachman.

Next she said to Cinderella, "Go again into the garden and bring me six lizards."

These her Godmother changed into six smart foot-

men, who jumped into their places on the back of the coach.

"This is just what you needed to go to the ball," said her Godmother.

"Yes, indeed," said Cinderella, "but must I go in these dirty clothes?"

Part 5, picture No. 1:

"Shut your eyes," cried her Godmother.

Cinderella shut her eyes tight and her Godmother touched her lightly with her wand. Immediately her dirty rags were changed into the most beautiful dress of silver and gold that you have ever seen, and on her feet were two dainty glass slippers.

"Now you can drive off to the ball," said her Godmother, "but remember one thing. *You must be home before the clock strikes twelve.* Promise that you will obey me, for if you stay away one minute longer, your beautiful clothes, your coach and your horses will change to what they were before."

Part 6, picture No. 8:

Cinderella promised, and away she drove to the King's palace.

At the door of the palace, the Prince helped her from her carriage and led her to the ballroom.

The Prince danced with Cinderella and she danced so gracefully that everyone admired her.

When supper was served, the Prince escorted Cinderella to the seat of honor. She shared the fruits and candies that the Prince had given her with her sisters who sat close by; but of course they did not know her.

When the clock struck eleven and three-quarters, Cinderella hastened away, but promised the Prince she would return to the ball on the next evening.

Part 7, picture No. 5:

When Cinderella reached home, she asked her Godmother to please let her go the following night. Her Godmother promised and while Cinderella was telling her about the ball, her stepsisters and stepmother arrived. Quickly her Godmother vanished.

Cinderella pretended to be asleep and jumped up as they entered. Rubbing her eyes, she said:

"Did you have a good time at the ball?"

"Oh, it was wonderful!" replied the sisters, "and we met a most beautiful princess who was most kind to us."

The next night her sisters went to the ball, and Cinderella went too; and her dress was even more beautiful than the night before.

The Prince was always with Cinderella and kept telling her how beautiful she was.

Part 8, picture No. 10:

When supper was served, she again occupied the place of honor beside the Prince, and she was so happy that she quite forgot the promise she made to her Godmother to be home before twelve o'clock.

On the first stroke of midnight, Cinderella jumped up quickly and ran from the room and down the stairs as fast as she could go—so fast that one of her glass slippers came off. She did not have time to pick it up. On she ran, and when she came out of the palace, alas! the coach and horses had vanished. She herself was in the same old dirty clothes she wore every day.

Part 9, picture No. 2:

When Cinderella rushed away, the Prince ran after her, but he could not catch her. Seeing her slipper on the palace stairs, he picked it up.

The next day, the King's herald went round the city. He said the Prince had found a glass slipper which belonged to a beautiful lady. The Prince had fallen in love with her, and if only they could find her, he would marry the lady who could wear the glass slipper.

All the young girls of the land came to try on this wonderful glass slipper, but it was so small that none of them could wear it.

At last the messenger came to the house where Cinderella lived.

First the stepmother tried it on, and no matter how she pulled and pulled it would not go on. Then the stepsisters tried and it fitted them no better.

Then Cinderella said, "Please let me try it on."

She tried on the slipper and it fitted perfectly!

Then putting her hand into her pocket Cinderella pulled out the other slipper.

Part 10, picture No. 4:

Imagine the surprise of the two sisters!

Suddenly Cinderella's Godmother was at her side. She touched Cinderella with her wand and again she was a beautiful princess.

Then the two stepsisters begged to be forgiven. But Cinderella, who was as good as she was beautiful, kissed them and told them she would always love them.

The King's messenger drove away with Cinderella to the palace where the Prince met her and made her his bride and they lived happily ever afterward.

Instructions: Prop the card of poster stamps in front of the subject and say, "You see these little colored pictures? I am going to read you a story to go with these pictures and I want you to see if you can pick out the right picture

to go with each part of the story. I want you to listen very carefully and when I finish each page you tell me which picture it was about." Start reading the story and stop at each of the ten places marked and say, "Now what picture goes with that page?" Time limit for the identification of each picture one minute. Caution the subject to keep his hands off the table until each page is finished and not to point to the picture until asked. Ask if he knows the story of Cinderella and has seen these pictures; note the answers.

Record: Record the picture chosen for each part of the story by the number of the picture as it appears on the card. Indicate a correct choice by X. Record the time for each choice that runs over ten seconds.

Evaluation: Ten points are given for each picture chosen correctly, making a perfect score of 100. The value in percent has been used for all work with the test.

Notes. The test was devised as an attempt to get into test form some factors intrinsic in education.* The material and the method do not duplicate school procedure yet the use of language and an appreciation of pictures and their stories are chief elements. The test also demands initiative and mental constructiveness and is presented in the form of a game, which makes it comparable with the other tests.

Although the illustrations do not look very clear, they seem to be easily identified by the children. All the subjects were familiar with the story from their school readers, and none of them had seen the illustrations used in the test. There are alternate pictures which seem to deserve some credit when chosen for certain pages. But since time did not permit our making an intensive study of all the choices made as a basis for an adequate standardization it seemed best to follow an arbitrary rule which was as simple and obvious as possible. It was our intention to develop a series

* Fable tests present an analogous situation, but are harder to administer if children of different ages are to be tested.

of pictures and stories that could be used interchangeably with "Cinderella," but we were prevented by lack of time. The test would seem to justify the work, and it would be valuable to arrange a story which might appeal especially to boys as "Cinderella" may to girls.

Identification of Forms (Woolley)

Materials: Two sets of geometrical forms, screen for the subject's eyes; stop-watch. One set of eight forms is mounted on a black ebonized board 10½x21x⅜ inches. The forms are made from ¼ inch board finished very smoothly, varnished and shellacked. The pieces are glued and screwed to the board as shown in the cut, the numbers showing the order in which they are given to the subject. The loose pieces for the subject to feel are identical with those on the board. In order not to frighten the children by bandaging their eyes a screen was devised from a folding music stand. The rack was covered with heavy cardboard and adjusted so that it slipped off and on the stand easily. During the test the stand is placed between the child's knees against the table. When the rack is in place there is ample space for the child to move his hands, yet it cuts off enough of his view so that it is very easy to prevent his seeing the pieces as he feels them.

Instructions: Prop the form board up in front of the subject. Say, "You see all these wooden shapes? I am going to put this screen in front of your face (adjust screen) so that you cannot see what your hands are doing. Then I am going to give you one of the shapes to feel of and after you have felt of it I will take away the screen and I want you to point to the shape on this board which is like the one you felt of. Here is one to practice with. Now rub your fingers round the edge of it so you will know what shape it is." Give the subject the sample and show him how to feel of it by guiding his fingers around the edge.

FIG. 5.—BOARD FOR IDENTIFICATION OF FORMS.

Take down the screen and ask him which piece it was. If he indicates the correct form say, "Yes, you see they are just alike," and place the sample upon its mate on the board. In case of error, give him the sample and say. "No, here is the one you had. You see it is like this one. Now feel of it again. Feel well of the others because you will have only one chance at them." Present forms in the order 1, 2, 3, 4, 5, 6, 7, 8. Allow the subject to feel a shape no longer than ten seconds.

Record: Record by number each choice as it is made.

Evaluation: A score is given in percent, 100 for a perfect performance, allowing 12½% for each choice. This score has been used in all work with the test.

Notes. This test was developed by Mrs. Woolley as an experiment to see if a situation could be presented to the children which would clearly involve the transfer from a kinesthetic to a visual impression. The test was kept in the series when it was made up on the basis of presenting a range of situations involving varied mental adjustments. From a purely objective standard the situation seems legitimate. It involves the type of discrimination and comparison which is common in life and is unlike many of the other tests in that it is not a task but guides the subject through a series of similar performances.

Instruction Box (Hayes)

Materials: Hayes Instruction Box. Stop-watch. The box is made of three-ply ⅛ inch board, finished in brown varnish. Cork water polo balls stained with red and green ink are used. The strips on the covers of the two hinged boxes are of shiny black paint ⅞ inch wide. The three sticks are made of ⅝ inch dowel stick, finished like the box. The holes in the end of the box are arch shape, large enough to let the unpointed end of the stick slip in and out easily. The buttons glued to the bottom of the four open

compartments should be wired in as the subjects often try to pry them off. Ordinary white pearl buttons are used.

Instructions: Present box with long axis crosswise to the subject and with the red ball at his left. The box with the three black lines on the cover, containing the three sticks should be toward him. Say, "You see this box with all these different parts?" Point to the four compartments and lift the lids of the covered boxes very slightly. "I am going to ask you to do several things with this box and I want you to listen very carefully so that you will remember all of the things I say and do them in just the order I tell you. First: Open the part of the box that has *three* black

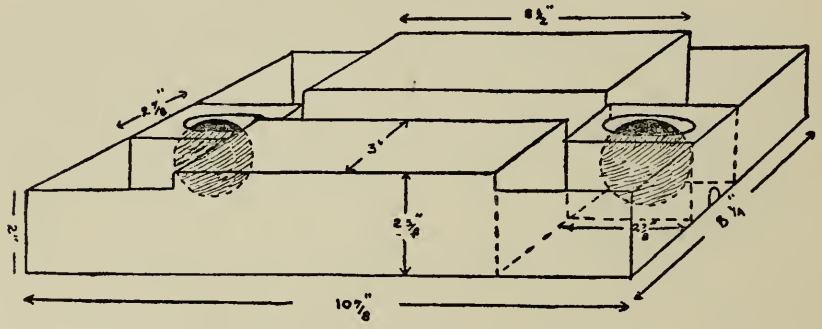


Fig. 6.—Instruction Box Dimensions.

lines on the cover. Second: Take out the *shortest* of the three sticks you will find there. Then put the *pointed* end of this stick into the hole at the end of the box under the *red* ball. Push the stick in as far as it will go. Next take out the red ball and put it into the part of the box that has the *largest* number of buttons. Lastly put the stick in the part of the box that has *two black lines* on the cover. Now I will tell you again so that you will be sure to remember." Repeat instructions verbatim from "First open the part," etc. Then say, "Now go ahead." Keep the box out of sight until used. Remember that this is an instruction test, and never vary in the least from the verbatim instructions. Encouragement of any sort should be avoided. No further

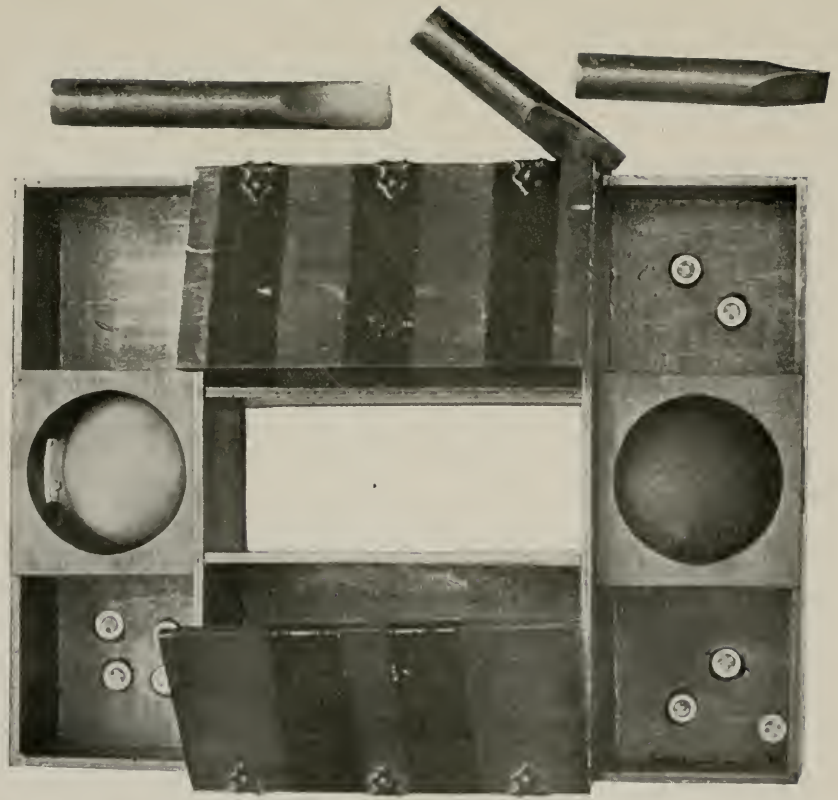


Fig. 7.—Instruction Box.

repetition of the instructions is allowed whether asked for or not. If any request is made, simply say, "Go ahead and do as I told you." Start watch immediately after "Go ahead" and stop it when stick has been placed in the box. Time limit of three minutes.

Record the time in seconds and the moves as follows, using X for a correct move and giving a full description of an incorrect one.

Moves:

1. Choosing and opening correct box.
2. Choosing and taking correct stick.
3. Choosing and taking correct ball.
4. Choosing and sticking correct end of stick in correct hole.
5. Choosing correct box and putting ball in it.
6. Choosing correct box and putting stick in it.

Evaluation: Rules for scoring moves.

1. Total omission of a move. Credit is given for those moves only which precede the one omitted.

2. Interpolation of a move wholly outside the instructions. Credit is omitted for all moves following the interpolated move.

3. Correction of an incorrect move. When this occurs before another move has been made it does not constitute an interpolated move. Neither does it give credit for the incorrect move, unless the correction is made before the false start is completed.

4. Confusion of two successive moves. Credit is omitted for these two moves. The later moves in the series are credited if properly performed. This covers the case in which the ball is lifted out with the fingers before the stick is used—whether or not the error is subsequently corrected.

5. Confusion of more than two successive moves. All the moves included between the serial limits of the confusion are omitted from credit.

6. Error in the performance of any move. Where something is done to represent this move in the series, and where this error does not involve any other moves in the series, credit is omitted for this move alone. Case 1. Looking in all boxes (including covered boxes) before putting away the ball does not constitute an error or interpolation. 2. Spearing the ball, prying it out with the stick or discarding the stick and using fingers alone, constitutes an error in move 3, not in move 4. 3. Taking out or attempting to take out the green ball at any point in the series, constitutes an interpolated move. 4. Digging out the buttons is prohibited and counts as an interpolation. 5. Putting back the ball in its own hole counts as an interpolated move. 6. Putting away the stick (correctly or incorrectly) immediately after using in taking out the ball, counts under 5 above, and takes away credit for succeeding moves. 7. Opening wrong box first for move 1 or 6, starting to move the green ball first, putting ball in wrong button box, taking the wrong stick and starting to use stick on top of the ball, if corrected before another move is made count as an error in this move only.

The time in seconds and the number of correct moves are noted for each performance; the latter number has been used for the norms and analysis.

Notes: Since following instructions plays such a large part in the school life of the child, this box was devised as an attempt to present a standard situation involving understanding, remembering, and carrying out specific instructions. The difficulty for the children of finding the hole at the end of the box and their failure to understand the purpose of the stick introduces a mechanical element that should be eliminated. A more elaborate mechanical* box would undoubtedly be better, as it would then be possible to have each move so distant that evaluation would be

* Such a box is described by Healy and Fernald in Tests for Practical Mental Classification, Psychological Monographs, Vol. XIII, No. 2, 1911.

easier, and to make each move depend on the one preceding it so that an error would block the performance. These two changes would eliminate the factors that seem to complicate the simple instruction situation in the present box.

Needle Threading (Hayes-Dewey)

Materials: Five steel sewing needles sizes 7, 8, 9, 10, and 11. Spool of Clark's No. 100 unglazed white cotton thread. Small sharp scissors. Stop-watch.

Instructions: Say, "You know how to thread a needle, don't you? Like this (illustrates with large sample needle No. 3.) Take the needle in one hand and the thread in the other. Now see how quickly you can thread this one." Present needle No. 7 and thread with freshly cut end. Repeat procedure with smaller needles unless the subject fails with two successive needles. Allow him to use his own method, with one limitation: he must not bite the thread. If he fails on one needle and succeeds on the next, repeat the failure. Take particular care to see that he faces the light. Time limit of two minutes on each needle. Encouragement is often necessary to keep the subject working at one needle for two minutes. Be sure the scissors are sharp, and that the end of the thread is not frayed in cutting.

Record: Record the time from the moment thread and needle are handed to the subject until he has pulled the thread through the eye of the needle; the number of each needle threaded and of each failure.

Evaluation: The time in seconds is noted for each needle. The number of needles threaded was used for norms and for analysis.

Nail Driving (Hayes-Dewey)

Materials: Piece of oak 7x8 inches and 1½ inches thick. Brad nails No. 18, measuring ¾, ⅞, 1, 1¼, and 1½ inches respectively. Small hammer, steel pincers. Small steel rule

marked in sixteenths of an inch. Five wooden nail sets. Stop-watch. The oak block is of seasoned wood so hard that it is difficult for an adult to drive the two longer nails in without touching them. The nail sets are used to insure each nail being set uniformly before being given to the subject. They are made of 1x1 inch wooden blocks one-fourth of an inch less in height than the nail to be set, through which a hole with a slightly larger diameter than the brad is bored. These sets should be made very carefully with the upper and lower surfaces exactly level and the hole at right angles to them or it will be impossible to set the nails straight.

Instructions: Say, "You know how to drive a nail, don't you? Take this hammer and hit the nail on the head but don't touch the nail with the other hand. Use the other hand to hold the board. (Illustrate.) I want you to see how quickly you can drive it clear into the wood but be careful not to bend the nail." Set the third nail (one inch length) for a sample. To use the set place it upon the oak block and hammer the nail down through the hole in the set until it is level with the surface. Then remove the set. Have the subject stand in front of the table and hold the block with his left hand. Say, "This is a sample nail to practice with. Hit it on the head with the hammer but don't take hold of it. Try not to bend it but if you do, you may straighten it with the hammer if you can. Like this" (illustrate). Do not allow the subject to use the claw end of the hammer to straighten the nails. Correct any defects in his procedure that might actually interfere with final success and continue the practice trial until he seems to have some conception of the process of hammering in a nail and enough force to drive it in, straightening it, etc., however do not extend the practice greatly over two minutes. Then set the shortest nail and say, "Now let me see how well you can do this one." Proceed with the other nails in the order of their length. Then repeat the series. Time

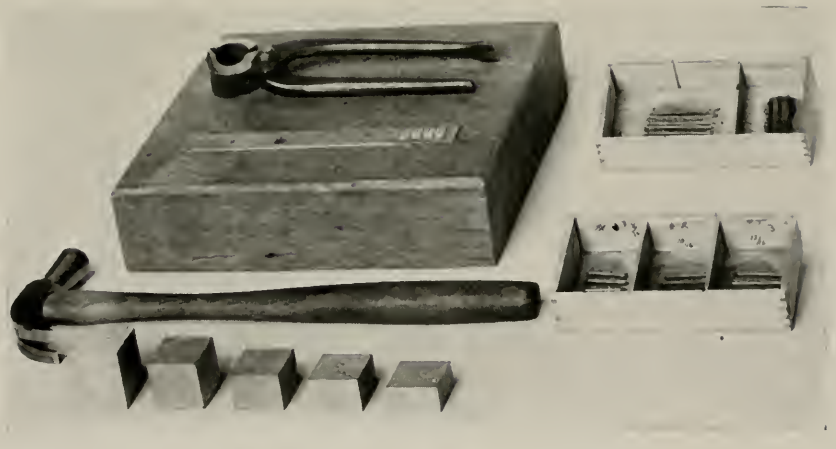


Fig. 8.—Materials for Nail Driving.

limit for each nail one minute. Have the subject continue until the time limit is reached or the nail is driven clear into the wood or bent in a curve so that straightening with the hammer is impossible, when the trial should be stopped and the time taken as sixty seconds. In order to remove and measure a nail not entirely driven into the block, the heavy steel pincers are used. Draw the nail and measure the portion embedded in the block.* Ask the subject if he has driven nails before and record the answer.

Record: Record the time in seconds and the distance each nail has been driven, in sixteenths of an inch. Denote a success by X.

Evaluation: The number of nails driven in completely was noted, the total time in seconds for the ten nails and the total distance in sixteenths of an inch that they were driven in were figured. The total distance is the value represented in the norms and analysis.

Notes: Threading needles and driving nails were included in the series since we desired tests of muscular adjustments which would not represent a purely artificial situation and which would minimize the element of understanding instructions. The administration of the nail driving portion of the test is so complex in order to make a standard evaluation possible and also to eliminate as far as possible factors in the process dependent upon experience. Having decided to present real situations we found that those which were adaptable were usually more familiar to one sex than to the other. Therefore nail driving was chosen as an activity more familiar to boys and needle threading as one familiar to girls. A button frame which had to be abandoned was intended to represent a situation familiar to both sexes.

The difficulty of keeping the material for these tests

*Since the tester sets each nail a quarter of an inch in the block before handing the hammer to the subject, this distance must be substracted from the total distance which the nail is driven into the wood.

standard is considerable. The oak blocks are not always of identical hardness, many nails are not straight and it is impossible to cut the thread so that the ends are exactly alike. Vision plays a part in the test, particularly in threading needles, which cannot be ignored.

Problem Box (Hayes)

Materials: Hayes Problem Box, set with six levers. Stop-watch.

Instructions: Present the box in an upright position with the door facing the subject. Say, "You see that this box has a small door here. This door is kept closed by the latch that slides across the edge of it. (Indicate step 6 and the direction of its movement). As soon as this latch is moved, the little door will swing open. Now I want you to see if you can find out how to slide the latch over and let the door open. (Point individually to each of the six levers.) Look the box over carefully and then begin." Time limit, eight minutes. After success reset the box where the subject cannot see the process and say, "Now see how quickly you can do it again." Time limit two minutes. After the second success say. "Now see how quickly you can lock the door just as it was at first." Time limit, two minutes. Keep the box out of sight until it is used. Do not explain or reconstruct after a failure. Warn the subject when he is using unnecessary force. Say, "They will all move easily when you get them right." Prevent him from slipping one latch out and over another or over a screw. When the subject's inability to move a latch evidently depends upon the latch's sticking, assist him. Ex.: 2 and 6.

Record: Record each move and attempted move of the subject. The latch which slides over the door is No. 6 and the series runs back from this. Indicate opening of lever by a line above the number and closing by a line below it. Group simultaneous movements of two or more levers by

FIG. 9.—PROBLEM BOX

enclosing them in a line or bracket. Indicate a prolonged pull at one lever by a wavy line under it.

Evaluation: The total number of moves; the total number of times levers are opened and the time in seconds is noted for each trial. A failure is counted as 481″. Owing to the difficulty introduced by the time limit, scores were used for the group of performances represented by the Jewish boys and girls of nine to thirteen years of age. These were obtained by assigning the values 5, 4, 3, 2, and 1 to each twenty percentile group of the ogive for seconds for the first trial. These tables were made up from the curves, and from them the appropriate score is found for each performance:

Boys		Girls	
Seconds	Score	Seconds	Score
1′ – 28″	5	1′ – 38″	5
29″– 47″	4	39″– 64″	4
48″– 78″	3	65″–119″	3
79″–199″	2	120″–306″	2
200″–481″	1	307″–481″	1

We give the percentage of subjects succeeding within the time limit; norms for the score and distribution curves for all age groups. The results for the second and third trial are not given since they seem to be useful chiefly as a comment on the eccentric performance.

Picture Completion (Healy)

Materials: Healy picture completion board and pieces.* Four blank pieces were used instead of the ten that come with the board, making a total of forty-four pieces. The pieces were arranged in four rows of eleven pieces, in a grooved box so that they could be propped up in front of

* Healy, W. A., A Picture Completion Test. Psychological Review, 1914, 21. Pintner and Anderson: The Picture Completion Test. Educational Psychology, Monograph, 1917, No. 20.

the subject; the flying bird, football, and log in the top row, the broken window and the dog in the second row, and the apples, cat, and hat in the third row; the chicken and wheel in the bottom row. The one-credit pieces are scattered among the others. Stop-watch.

Instructions: Place the pictures in front of the subject. Prop the box containing the pieces behind the picture and facing the subject. Say, "Any one of these pieces will fit in any of the holes. They are all the same shape and size but they have different pictures on them. What I want you to do is to find a piece to put in each hole that will complete the picture and make sense of it. For instance, what is missing here? (Point to place for the wheel.) You see the man and the wagon, now what is needed to finish the picture? (Ask enough questions to obtain the correct answer.) See if you can find a wheel to put in there. Yes. That is right. Now that is what I want you to do with each of the holes. Look carefully at the picture and see what is missing. Then look at the pieces and find the one that you need to make sense." Put the wheel back among the other pieces and say, "Now go ahead." Start watch as the subject begins to study the picture and stop it as the last piece is put in. Time limit of eight minutes. When the time limit has been reached or the subject has filled all the holes, note the time and check the record of moves to that point. Part II. Then say, "Now look at the pieces carefully and see if they are all right. You may change any of them that you wish." The subject was allowed to work for two minutes more on the picture unless he said it was all right immediately.

Record: Record the time in seconds and each piece put in, removed or exchanged by the subject, for Parts I and II separately.

Evaluation: Score the pieces as they stand when the last piece is put in before the suggestion to correct errors is given. The pieces were scored according to the values

assigned by Dr. Healy, each correct piece receiving two points and the following pieces one point each:

Correct Piece	Alternate—One Point
Window	Unbroken window
Football	Baseball
Flying Bird	Standing bird, blank
Chicken	Mouse, cat
Cat	Cat from rear
Hat	Purse
Log	Axe
Basket	Baby

Part II was given since Dr. Healy includes such a suggestion in his instructions for the test; but the changes made were not recognized in giving the score since we have consistently followed the plan of getting the subject's immediate reactions, without giving supplementary instructions which might prove helpful. Norms are given for the score and time in seconds for the unprompted performance and for the index which represents the actual relation of time and score for the Jewish boys and girls of nine to thirteen years. The index is the value selected for analysis of the test and is figured from the following formulæ:*

Boys	Girls
$10.803+0.134E-0.003T$	$11.070+0.099E-0.0017T$

Substitute the time in seconds and the score for T and E respectively, and the result is the score for the individual.

Notes: Owing to the impressionistic drawing of some of the pieces the subjects were unable to identify the pictures. The most frequent example of this was the broken window which was repeatedly called a spider. The football and baseball also gave trouble frequently enough to be noted.

The number of nonsense pieces put in was very large,

*These formulæ represent the regression of score and time on age.

which would indicate that the instructions were not always adequate for a real understanding of the problem. The children did not consistently follow the instruction that they look at the picture and decide what was needed and then look for the proper piece; but they looked at the board as a whole and then picked out a promising piece and tried it in several different holes. It also seemed quite likely that many of the worst mistakes could be accounted for by the extreme unfamiliarity of our group of children with the scenes depicted in the picture. The majority of the subjects had never been in the country, had seen parks only at rare intervals, and had never seen the activities of the picture taking place. Some subjects even asked what the apple tree was.

Memory for Objects (Ellis)

Materials: Set of ten Ellis memory objects;* strip of manilla paper; stop-watch.

Instructions: Say, "Now I am going to show you some interesting things, and as I put each one down you tell what it is. What is this? And this?" etc. Put the ten objects down, one at a time, in front of the subject in a row beginning at his left. (Use strip of manilla paper under them.) Use the order listed below and wait for him to name each object before putting down the next. If he calls any object by a name that may result in its confusion with another object, ask him to look again. If necessary tell him what it is. (Calling the dog a horse may confuse it with the horse and rider.) Aside from this limitation allow him entire freedom in the terms he employs. After all the objects are named say, "Now I want you to tell me again what each of the objects is and notice the order in which they come. After that I am going to take them all

* Set of objects may be obtained from Mr. F. W. Ellis, Neurological Institute, New York City.

Fig. 10.—Ellis Objects.

away and I want you to ask me for them in just the order they are in now. So be sure to remember how they come." Point to each object from 1 to 10 and allow the subject to name it. Then take all the objects away and say, "What came first? Yes, then what?" etc. As the subject names the objects place them in a row from left to right in front of him. If he fails for 30″ to name any particular object, say, "Well, what comes after that?" At the end of the series, if any objects have been omitted allow him to supply them. Say, "Is that all? Are there any others?"

Order of presentation:

1	2	3	4	5	6	7	8	9	10
Hat	Car	Dog	Shoe	Rider	Gun	Chair	Axe	Cup	Hen

Record: Record the series as called for by the subject, using X to represent an object correctly placed. If he says he does not know what comes in a certain space but thinks there was something there, leave space for this.

Evaluation: Perfect performance—100%. In an incorrect performance credit 10 for each object correctly placed. Deduct 1 for each place an object must be moved to bring it to the correct position. This value in percents was used for all work with the test.

*Notes:** The test was not given in the complete form used by Mr. Ellis because it was impossible to assign numerical values to the purely qualitative associations he calls for. However, the test seemed worth including because in form it is much like the rote memory tests in common use, but it has a strong affective factor. The little objects are interesting to children, making sufficient appeal so that they stop and examine the objects, exclaiming over them. This introduces a recognition factor which complicates the

* Ellis, F. W., and Bingham, Anna L.: Report of Mental Examinations, Seventh Annual Report of the New York Neurological Institute. For another method of giving the test see: Agencies in Social Welfare, Bulletin of State Board of Charities of New York, No. VIII, 1917.

situation beyond that where the subject simply reproduces the material without meaning for him. The comparison of the two types of performance should be interesting for the study of the individual.

Knox Cubes

Materials: Four one-inch cubes mounted on a narrow board, two inches apart and one single cube, made of dark varnished wood.*

Instructions: Lay the cubes on the table in front of the subject. Say, "Watch carefully and then do as I do." Take the single cube and begin tapping the blocks at a constant rate (about one per second.) Always begin with the cube at the subject's left. Never repeat a line, even if the subject goes through the line from the wrong end. If the subject does unusually well, question him as to his method and make a note of the kind of counting that would help him remember. Tap the cubes in the following order:

a—1 2 3 4	*e*—1 3 2 4 3	*h*—1 4 3 1 2 4
b—1 3 2 4	*f*—1 4 3 2 4	*i*—1 3 2 4 1 3
c—1 4 3 2	*g*—1 3 1 2 4	*j*—1 4 2 3 4 1
d—1 4 2 3		

Record: Let x represent the correct reproduction of a series. Record the series as given by the subject in case of an incorrect reproduction.

Evaluation: Score each series as plus or minus and add the pluses; perfect reproduction of all the series—10.

Notes: In using this test we made the mistake of fixing the amount that should be required for subjects of different ages. (See notes on Digits.) The variation is so wide within an age group that unless the test is to be evaluated as an age level test, the material should be given complete

* Knox, H. A.: A Scale Based on the Work at Ellis Island for Estimating Mental Defect. Journal of American Medical Association, 1914, p. 62. Pintner, R.: The Standardization of Knox Cube Test, Psychological Review, 1915, p. 27.

to all the subjects. We present norms for eleven to thirteen year old children and the complete results are presented in the form used by Pintner. In making comparisons, however, it should be noted that the practice trials x and y were not used.

Healy Construction Puzzle "A"

Materials: Healy "A" puzzle; frame and five pieces.* Stop-watch.

Instructions: Present frame and pieces to the subject as shown in cut Nos. 11a and 11b. Say, "You see this frame and these pieces. If you put these pieces in here just right, they will all go in and just fill up the space and no pieces will be left over. Now you go ahead and see how quickly you can get them all in." Start the watch as soon as the instructions are finished. Stop it when the last piece is put in correctly. If the puzzle is not completed at the end of eight minutes stop the test. If it is done within eight minutes, turn the pieces out and arrange as before. Then say, "Yes, that was right. Now let's see you do it again." Care should be taken to turn the pieces out immediately upon its completion, even before the time is recorded. Eight minute time limit for second trial if necessary.

Record: Record the time in seconds for each performance and the subject's moves in the following way:

/=correct move
V=incorrect move
X=impossible move

Always note the turning out of all the pieces for a fresh start, and the completion of the puzzle with the exception of placing pieces 4 and 5. The correctness of the position

* Healy and Fernald: Tests for Practical Mental Classification, Psychological Monographs, Vol. XIII, No. 2, 1911.

of 2, 3, 4, or 5 is always to be judged with reference to the pieces already in place, i.e., the same piece may be either right or wrong depending on what has preceded it. Any position of a piece which, if not altered, will block the completion of the problem in an incorrect position. An impos-

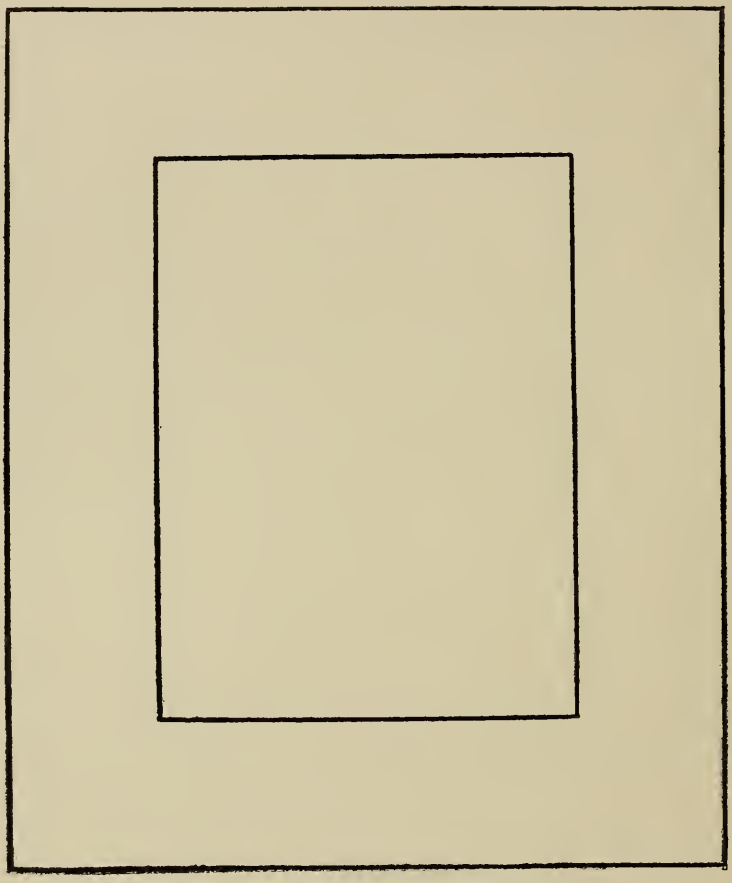


Fig. 11*a*.—Position of Pieces for Healy "A."

sible move is the attempt to force a piece into a space too small for it.

Evaluation: Note the number of right, wrong, and impossible moves; the total number of moves and the time in seconds for both trials. Record a failure as 481″. The second trial was given as an aid in evaluating the test

situation and in order to furnish additional data on the eccentric child; hence the results are not presented here. The time for the first performance was selected as the test value, since moves and time correspond very closely. The percent of failures, distribution curves for the age groups and norms for the score are presented. The scores are assigned from the following tables which were made from

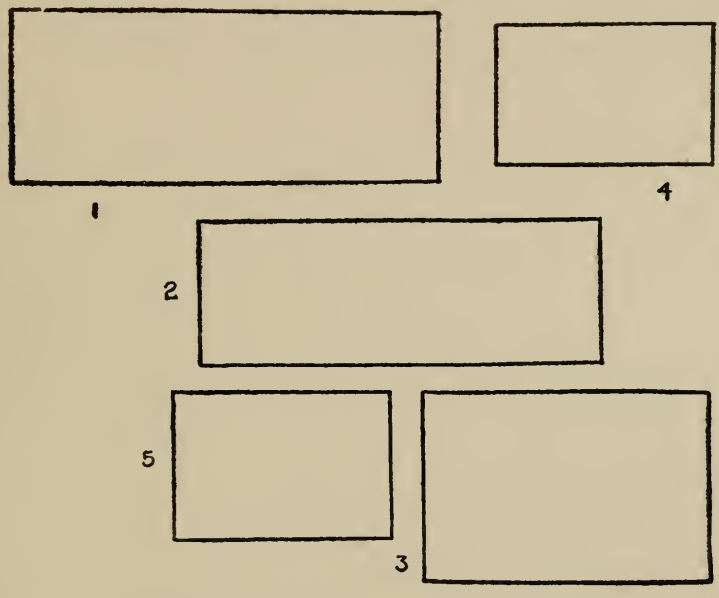


Fig. 11*b*.—Position of Pieces for Healy "A."

the ogive for the nine to thirteen year Jewish boys and girls, by giving a score of five to the highest 20 percent, four to the next 20 percent. etc. (See notes on Problem Box.)

Boys		Girls	
Seconds	Score	Seconds	Score
1′ – 35″	5	1′ – 40″	5
36″– 78″	4	41″– 88″	4
79″–143″	3	89″–152″	3
144″–278″	2	153″–350″	2
279″–481″	1	351″–481″	1

Healy Construction Puzzle "B"

Materials: Healy "B" puzzle form and eleven pieces.* Stop-watch.

Instructions: Identical with those for Healy A.

Record: Record the moves as follows:

/=correct move
V=incorrect move
X=impossible move

A correct move is the placing of a piece in the correct position or the removal of a piece from an incorrect position. An incorrect move is the incorrect placing of a piece or the removal of a piece already correctly placed. The removal of a piece from an impossible position counts as a correct move. Special note should be taken of the repetition of incorrect or impossible combinations and the interchange of interchangeable pieces. Draw the stand of the puzzle in case of a failure.

Evaluation: Figure for each trial the time in seconds and the number of right, wrong, and impossible moves and the total number of moves. Because of the large number of failures it was impossible to score the cases from the distribution as in Healy A, but the method of giving the test and the results in seconds are included in this volume because with the extension of the time limit the test should be applicable to such a group of children.

In making records the removal of a piece was recorded as well as its placing in order to get as complete a picture of the performance as possible. A removal has as much to do with the speedy or slow completion of the problem as placing a piece. Filling the frame involves the solution

* Healy and Fernald: Tests for Practical Mental Classification, Psychological Monographs, Vol. XIII, No. 2, 1911.

of a single geometrical problem of space relation—a puzzle situation. In our attempt to get into quantitative terms

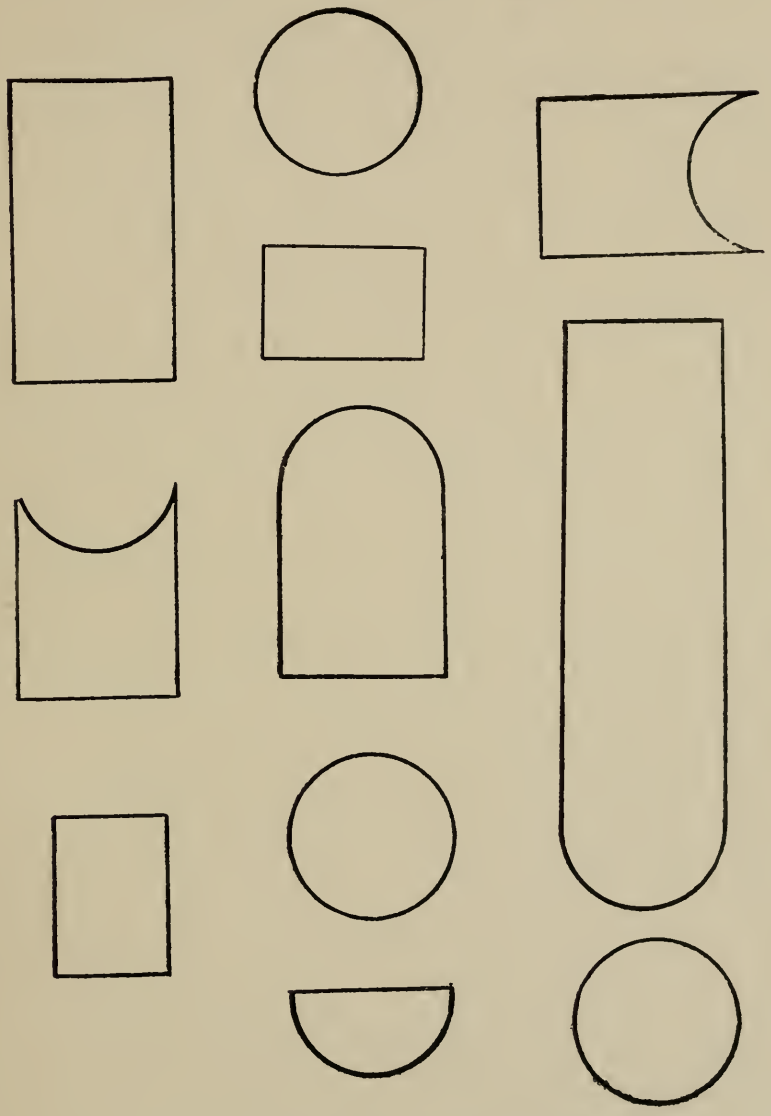


Fig. 12.—Position of Pieces for Healy "B."

the slant on eccentricities which such tests give it seemed worth while to take a record which would as nearly as possible reproduce the performance.

Notes on Healy Puzzles and Problem Box: The recording and evaluation of Healy "A" and "B" present peculiar difficulties for the mass use of material. Clinical psychologists have found this type of test particularly helpful in the diagnosis of the individual. Therefore in order to discover whether these qualitative values would appear in an objective history of a performance we decided to take as full records as possible. There is no doubt that the tester in watching a subject fitting the pieces into the frame feels that he is getting a picture of the subject's method of attack and powers of carrying through a task that is afforded by few other tests. While certain types of performance stand out definitely, an analysis of any one performance on its completion usually led to the conclusion that the subject had followed more than one method and that in each case the methods overlapped. Although to us who have used the tests the notes on the record blanks often suggest the performance, we were unable to find anything in the uniform records of the moves that could be used as a numerical measure of the kind of performance that took place. Even if a qualitative value had developed it would still have been necessary to determine its significance.

The tests are, however, suitable for quantitative use, although they present difficulties not found in tests where it is possible to score the amount accomplished in spite of errors. This is also true of the Problem Box. The available time in testing a large number of children makes it necessary to set a limit to the time allowed any one child to work on a test. Even with a limit of eight minutes the number of failures was so large among our subjects that these cases could not be ignored, nor could they be treated as of equal value since some subjects may have been about to finish the test while others may have been as far from success as when they started, and there is nothing in what has been accomplished to justify an evaluation of the incomplete performance. Therefore when the number of failures is sufficient

to be recognized as occurring normally, the test becomes an all or none test. But the value of the results would be unnecessarily limited if a subject were scored simply plus or minus for the test. The time in seconds or the number of moves gives an excellent distribution of the successes. A descriptive use of the tests is of course possible where the failures do not constitute over a quarter of the group, this method permitting the comparison of an individual case with the normal as represented by the total group tested, but still not giving a quantitative value which can be used comparably with the values for the other tests. We therefore were forced either to disregard the test for analytical purposes or give each subject a score which represented the relative position of his performance in the distribution of the total group. The latter course was chosen.

Card Sorting (Jastrow)

Materials: Jastrow card-sorting apparatus with pack of 48 cards with red, yellow, blue, and green discs;* stopwatch.

Instructions: Place the box in front of the subject so that he can drop the cards in easily; i.e., with his hip on a level with the upper front edge of the box. Be sure the light falls directly on the color discs and never in the subject's eyes. Say, "Do you see this box with the four parts and a color on each part? Do you know what colors they are? What is this? and this?" etc. If the subject cannot name the colors have him match them with the cards. "Now each one of these cards is marked with one of those colors. (Show several.) What I want you to do is to drop each one of these cards into the part of the box marked with its own color and see how fast you can do it. Drop all the cards with the red in here (indicating motion of drop-

* Jastrow, J.: A Sorting Apparatus for the Study of the Reaction-Times. Psychological Review, 1898, 51.

ping) etc. If you should make a mistake and drop a card into the wrong part of the box, do not stop to change it; that would take too long. Just go right ahead and see how fast you can get them all done. You use your right hand? Take the pack in your left hand (right hand for left-handed child, present pack back upwards) and when I say 'Now begin,' turn the *whole pack* over (illustrate) and start dropping them in one by one as fast as you can." Place the subject directly in front of the box with the cards in his left hand. Say, "Now begin." Start watch after pack is turned over and just as the subject picks off the first card. Stop it as the last card leaves his hand. Give a second trial saying, "Now let's see how fast you can do it again. Do it just the same way. Turn the pack over when I say 'Now begin' and start dropping them in as fast as you can." Take the time as in the first trial. Correct the subject if he does not turn over the whole pack, and prevent his correcting errors.

Always arrange the cards in the pack in a fixed order so that the colors alternate in the following way:

G.....R.....B. .....Y
G.....Y.....B.....R
G.....B.....R.....Y
G.....Y.....B.....R
Y.....B.....R.....G
Y.....G.....R.....B
Y.....R.....B.....G
Y.....G.....R.....B
R.....Y.....G.....B
R.....B.....Y.....G
R.....G.....Y.....B
R.....B.....G.....Y

Record: Record the number of seconds and of errors for each trial. Note the nature of the errors, as R in B, Y, or G, etc.

Evaluation: Figure the time in seconds for each performance, and the accuracy in per cent: 100% for a perfect performance, and the number of errors divided by the total number of cards (48) for a performance with errors. The

number of errors was so small and made such an insignificant differentiation of the subjects compared with the time, that time for the faster performance was chosen as the value for all work with the test.

Notes: Woolley Indices. The method used by Mrs. Woolley in computing indices for tests where it was desired to express a combination of speed and excellence of performance in a single numerical value* is to divide the time in seconds by the percent of accuracy. Mrs. Woolley speaks of the indices as the estimated time for a perfect performance, but she herself points out some of the reasons why even on apriori grounds it is not safe to assume that a longer time results in fewer errors. Chief of these is the fact that errors of which the subject is conscious nearly always cause hesitations and pauses which appreciably lengthen the time. Too much haste is by no means the only reason for errors. Therefore, in spite of certain advantages of simplicity, we rejected this index because it involves assumptions which are difficult to maintain. Where we have used indices for tests of this kind, we have combined speed and accuracy in such a way that the index might have the highest possible differentiating value between children of different ages within the age limits of this study.

Cancellation (Woolley)

Materials: Stoelting cancellation blanks of small letters; one canceled and one fresh. Stop-watch.

Instructions: Take one *hpl* and one *zcy* sheet, one of them canceled. Turn the new sheet face down in front of the subject. Pointing to the other say, "You see this sheet with all these letters printed in rows. The other side of this sheet is just like it. Now what I want you to do is to go through that sheet row by row, and draw a line through every 'a' you come to, and see how fast you can get

* Card Sorting, Cancellation, Substitution.

the page done. Do it just as they are done here." (Show the sample sheet making sure that the subject understands.) "Be careful to mark only the 'a's.' If you should make a mistake and mark the wrong letter, don't stop to rub it out or try to change it for that would take too long. Just go right ahead. I want you to mark every 'a' on the page and see how fast you can get it done." Turn over the new sheet and say, "Now go ahead." Start the watch when the subject begins to look at the first line and stop it when his eyes leave the last line. The first few lines should be carefully watched and any errors in procedure corrected at once. For instance correct scrubbing out the "a's," making a cross through them, underlining them instead of marking them, etc.

Record: Record the time in seconds. There is no time limit.

Evaluation: Always use an evaluation stencil. Place it over the page so that all fifty "a's" are visible. Write on the right margin of each row of the blank the number of "a's" correctly marked by the subject, and in the left margin the number of omissions. Indicate letters wrongly crossed by a minus in the margin. Take away the sheet and mark any other letters crossed. A line running between two letters, an "a" and another letter and touching neither, no error. A single line crossing the "a" which runs into part of another letter, no error. If both "a" and the next letter are equally crossed, no error. A line made so carelessly that it crosses the letter next the "a" instead of the "a" is counted an error. If the line touches the "a" at all, count the "a" too. Scrubbing the "a" (not several distinct lines) so that the adjacent letters are touched, no error. Making a second line to correct the first if either line passes through a letter other than the "a," count the "a" and a minus one for a letter incorrectly crossed.

If no wrong letters are crossed figure the percent of accuracy directly from the number of "a's" crossed (50 on

a sheet). If wrong letters have been crossed, find the percent of accuracy by dividing the number of "a's" crossed by fifty plus the number of letters incorrectly crossed.

An index representing the relation of time and accuracy for the nine to thirteen year Jewish boys and girls was made. This was used for all work with the test and is figured from the following formulæ:*

Substitute the time in seconds and the accuracy in percent for T and E respectively; the result is the score for the individual.

Boys	Girls
$11.379+0.027E-0.007T$	$10.629+0.035E-0.007T.$

Notes: In making the rules for letters incorrectly crossed the attempt was made to prevent penalizing for a careless use of the pencil due to haste. However, since the instructions include an illustration of the best method of canceling and the warning not to correct errors, it seems fair to count as an error a letter which was crossed owing to a faulty method even when the correct letter was intended or marked as well. The rules were made after considerable experience in evaluating the blanks, and seem to us to follow the emphasis of the instructions as fairly as arbitrary rules can. But the fact that such complex rules are necessary in using the blank may be considered a fault in the test. The difficulties which we found in using the test all seem traceable to the type of blank used. The test is noticeably hard on some subjects' eyes; and it seems certain that eyesight plays a fairly important part in the test. The instructions are not always adequate. The difficulty of making a child understand without any learning period the necessity of making one single line so carefully that it will hit only the "a" and still hurrying through the blank as fast as possible is considerable. If the letters were larger the effect of the manual precision of the subject would be practically eliminated, and it would be possible to place due emphasis

* These formulæ represent the regression of accuracy and time on age.

on speed without handicapping accuracy.* (See note on Card Sorting.)

Substitution (Woolley)

Materials: Woolley Substitution blanks; key card and holder; card-board cover; stop-watch.

Instructions: Stand key card in front of the subject. Give him substitution blank 1. Say, "You see this page of figures? On this card there are just the same figures but each figure has a number on it. What I want you to do is to write in each figure on this page the number that you see in the same figure on the card. For instance what would you put in here?" Point to one of the confusional pairs. If the subject makes an error. say "No, look again." And

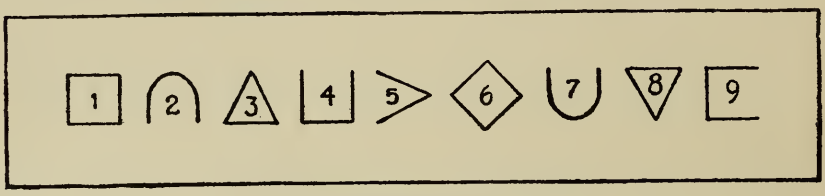


FIG. 13.—Substitution Key Card.

in here? (Point to one of the unique figures.) Begin here at the top of the page and fill in the figures in rows just as you come to them. As you finish each row I will cover it up with this piece of paper. (Illustrate several rows.) Now begin and see how fast you can get it done." When the first page is finished, record the time on it and turn to page 2 and say, "Now fill in this page and see how much faster you can do it." Record time at end of page. At the beginning of the third page, say "Now see how much faster you can get this page done and when it is done, I am going to take away the card and let you do this page (show

* For Cancellation, Substitution, Digits, Card Sorting, Strength and Steadiness, see Woolley and Fischer: Mental and Physical Measurements of Working Children, Psychological Monograph, Vol. XVIII, No. 1.

4) without it, just from memory." Turn down the key card as soon as the subject finishes page 3. Record the time. Turn up page 4 and say, "Now go ahead." Start the watch as the subject starts to look at the first figure on a page and stop it as he writes in the last figure on that page. Be sure to cover each line as he finishes it. Watch the first few lines of page 1 carefully and if the subject has misunderstood the directions, correct him at once; if he skips, point to the figure next in order and say, "Now this one." If he starts filling in with 1, 2, 3 in order say, "No. Write in the number that is in the figure on the card," etc. If the error is simply one of mistaking the number of a figure, let it pass. The following key was used, but any combination of figures can be used which separates the confusional figures.

Record: Record the time for each page.

Evaluation: Reckon the time in seconds and the accuracy for pages 1, 2, 3, and 4. The accuracy for each page is obtained by giving 100% for a correct page and subtracting 2% for each error. Add the time in seconds for pages 1, 2, and 3. The norms represent the time in seconds for each page, the accuracy for page 4, and the total time for pages 1, 2, and 3. The last value was the one selected for analysis of the test.

Notes: The test is one which is easy to give, easy for the subject to understand, and which involves a definite and common type of adjustment. However, before adoption, it should be carefully studied in relation to the use that is to be made of it, so that its full value can be obtained from the results. For instance, the situation would be simplified in attempting to regard the test as a whole if the warning that a fourth page was to be filled in from memory were given either before the first page or not at all. The latter course would probably result in a fourth page that could be evaluated more easily, since the amount learned would probably differ from subject to subject.

Page 4 obviously presents a different test situation with a memory factor, largely lacking in the first part, predominating. The best value for this would be one which represents the extent to which the practice pages resulted in learning as shown by the performance for the fourth page. Time alone seems an inadequate measure of memory. By our method the practice pages resulted in a perfect or nearly perfect recall of the correct figures in filling in page 4. Therefore accuracy alone is an inadequate value; it gives little or no differentiation of the subjects. It was impossible to combine the time and accuracy into an index on the basis of their observed relation as was done for Cancellation and Picture Completion, since the relation changed for subjects of different ages. Therefore page 4 is omitted from our statistical study.

Although Mrs. Woolley treated the results on each page as a separate test, the situation for pages 1 and 2 is identical and that for page 3 is only slightly altered by the warning that a fourth page will follow without the key. Therefore it was decided to use one value for the three pages. Accuracy gave relatively small scattering, so high a percent of the cases making no mistakes that it was ignored, and the time combined for the three pages.

Memory for Digits

Materials: Set of eleven cards of 5, 6, 7, 8, and 9 digits and a sample card of 4 digits; a metronome. The Stoelting cards for Whipple's Test 38A were used.

Instructions: Place the metronome and cards, face down, on table in front of the subject with paper in place most convenient for the subject to write. Say, "On the other side of these cards are some numbers printed in rows. I am going to turn a card up and then we will read the numbers out loud together. Then I will turn the card down and I want you to see if you can write the numbers

on this paper just the way they were on the card; just the same numbers and in just the same order. I'll start this little ticker going to show us how fast to read the numbers. (Start metronome at rate of 60.) See, we say a number every time it ticks. (Illustrate.) This first card is to practice on. There are four numbers on it. Be sure you read the numbers out loud with me and then write them down." Turn up a card on one beat of the metronome and start reading on the next. Repeat the procedure with the sample card until the subject understands the instructions. Then say, "Here is the first card, there are five numbers on it." Tell the subject the number of digits on each card before turning it up. Do not stop the metronome until the subject has written down the last number of the last card. Always present the cards in the order shown below.

1. 84627	5. 6914253	9. 831754629
2. 57296	6. 4863517	10. 924738615
3. 683152	7. 87461953	
4. 935274	8. 79435681	

Evaluation: With the correct series for reference check each series as right or wrong. Use as score the number of digits (5, 9, or 7, etc.) in the longest series correctly reproduced. Only one success out of the two trials is necessary and no account is taken of skipping a series.

Notes: The test in this form seems to give a uniform opportunity for maximum effort from every subject, since it makes a visual, auditory, and lip-motor appeal. The possibility that a subject with a dominant type of imagery would be badly hampered by a method which appeals chiefly to one sense is thus avoided.

When this test was included in the series the plan was to score it by the Woolley method. Since this allows a fairly detailed scoring according to the amount accomplished for each series, it was legitimate, though arbitrary, to decide that the limit for the younger children should

be seven digits, while the series given to the older subjects should include eight and nine digits. But when the span is used as the test value, a new basis for evaluation is introduced. As long as the subject succeeds in reproducing a series he should be given the next longer one, until his limit is surely reached. By stopping the test at seven digits for the younger children we practically invalidated the results for those who succeeded. If they can repeat seven digits they may be able to repeat eight, and until we know whether they can, the score seven is unfair. Whenever a graded series of tests is given, care should be taken to include material that is well beyond the range of the majority of subjects or it will be impossible to use the number of correct performances as the score.

We gave up the Cincinnati method of scoring because its advantage in giving a picture of the subject's complete performance was offset by the complexity of the scoring rules and by the fact that the method gives five or more separate values for the test in place of the *one* necessary for our purpose. When we made the change to the span method of scoring, we found that enough eight and nine year old children succeeded in reproducing seven digits to indicate that our norms for those ages were inadequate. We give results for ten through thirteen years, with the suggestion that the span is the best value for the test. Three arrangements of digits should be presented for each series and cards containing at least ten digits should be included. The test should be continued until a subject has failed on all three trials of two successive spans.

Steadiness of Motor Control

Materials: Electric target apparatus, stop-watch; table and adjustable chair.

Instructions: Adjust the subject at the table so that his elbow is level with the target and as far forward as the

front of the body, and his feet are on the floor. Have the target directly in front of the hand used. Say, "This is a machine to measure how steady your hand is. See I hold the point of this needle in one of these holes (illustrate). When I hold it still nothing happens but as soon as my hand moves a little and makes the needle touch the side of the hole, it makes this click (illustrate). I want you to put the point of the needle straight into the hole like this, and hold it just as still as you can in the middle of the hole. Make just as few clicks as you can. Now you try it." Have the subject try with the right hand in hole No. IV, until he holds the position correctly. Give every assistance to assure correct position for his hand. Repeat whenever necessary during the test. Say, "Yes, that is right. I will tell you when to put the needle in and when to take it out. Don't mind the first few clicks when you put the needle in, they don't count anyway." Begin with hole No. IV and start the watch as the subject puts the needle in. After 18″ tell him to take it out. Do not count the clicks for the first three seconds. If he makes four to twelve clicks inclusive, have him try the next smaller hole for the next trial with that hand. If he makes not more than three clicks, skip to the second smaller hole. If he makes more than twelve clicks, try the next larger hole. Continue the test until the examiner is sure he has identified the hole in which the subject makes not more than twelve clicks. Alternate the hands in giving the trials. Never try twice with the same hand without giving a rest. Be sure the needle is put into the hole at right angles; that it does not come out of the hole during the trial; that the subject does not press his arm against his body; that he does not rest the needle point against the side of the hole or rest his finger on the face of the target; and that his feet are flat on the floor. The holes are numbered in order from the largest to the smallest.

Record: Record the hand used, the hole and the number of contacts made for each trial.

Evaluation: Check for each hand the smallest hole reached with twelve or less contacts. Give this trial the correct value from the following table by adding the number of contacts to the numerical value of the hole. For example, 5 contacts in hole IV receives a score of 71. The smaller the score the better the performance.

Hole	Value
IX	1
VIII	14
VII	27
VI	40
V	53
IV	66
III	79
II	92
I	105

The scores for both hands are given as norms. The score for the right hand was used for the study of relationships.

Notes: The successful administration of the test depends on making the subject understand the problem in spite of the nature of the apparatus. The electric battery sometimes alarms the children and the strangeness of the whole situation is apt to make them tense and awkward. It is often necessary to spend a little time explaining and handling the apparatus before the subject overcomes his distrust and resumes a sufficiently natural and relaxed manner to enable him to hold the needle steady. The fact that a contact makes a click and a spark, suggests that making clicks is the proper way of handling the materials. This interest in producing clicks must be overcome by an adequate emphasis on holding the hand still so as to avoid them. But care should be taken not to prolong the period of instruction and practice so that it results in training.

The Cincinnati method of recording the number of con-

tacts and the hole reached as two separate values was followed, but for use these two values were combined into one.

Strength of Grip (Whipple No. 6)

Materials: Dynanometer.

Instructions: Show dynanometer to the subject and say, "This machine is to measure how strong your hand is. It works this way. I take it in my hand and squeeze it just as hard as I can. (Illustrate.) The harder I squeeze the farther those pointers move on the scale, and this one stays up to show how hard I squeezed. Now hold out your hand and let me see you take hold."

Adjust the dynanometer so that the lower edge of the upper grip lies along the base of the middle fingers and the lower edge of the lower grip lies against the heel of the hand.

"Now you take it, hold it down at your side, and squeeze just as hard as you possibly can."

Give three trials with each hand, alternating right and left. Keep urging subject to the maximum effort. Watch the subject to prevent his pushing instrument against side. Give him the dynanometer with face outward from body.

Record: Record the trials for each hand in kilograms and halves.

Evaluation: Note the best trial for right and left hand and the average of the two; these values are presented as norms, while the value of the right hand was used for analysis.

Notes: Unlike most of the tests in the series, obtaining comparable results depends less upon a verbatim administration of the test than upon securing the maximum of effort from the subject. Unless the tester constantly stimulates each subject so that he squeezes as hard as he can the results will not be comparable. Some children get the idea instantly, and with no further instructions than the explana-

tion of the apparatus, put their best efforts into all six trials; others have to be urged before each trial to insure their giving more than a perfunctory squeeze.

The size of the dynanometer, which is made for the adult hand, makes the test unfair to some subjects. The bars of the grip are so broad and thick that the smaller children cannot get a very firm hold and so are probably considerably handicapped in their performance. But, since it is obviously impossible to have a sufficient number of dynanometers to exactly fit the hands of all children from eight to thirteen years of age, and since the result cannot be regarded as an absolute physical measure, the inequalities of the results seemed to be minimized by giving the same instrument to all the subjects and making every effort to secure maximum effort.

Ball and Field Problem (Terman)

Materials: Blank with broken circle printed in heavy black ink.* Stop-watch.

Instructions: Present card with the "gate" toward the subject. Say, "This circle represents a big round field with a fence around it. You know what a field is? (If not, explain.) A baseball has been lost in this field but we have no idea where it is, in what part of the field. The field is covered with high grass so that you can't see the ball unless you get right close to it. (Start the path with pencil up to the gate.) Now draw a line that will show me how you would walk so as to be sure not to miss the ball." Allow the subject to continue till the pencil comes to rest for ten seconds. Then say, "Are you through?" Allow further drawing if the subject desires.

Record: Take time from the moment the subject starts drawing till pencil stops. If he continues after question, add on this time.

* Terman, L. M.: The Measurement of Intelligence, Houghton Mifflin Co.

Evaluation: By reference to the sample types shown in cut, score the performance as A, B, C, or D. Figure the time in seconds.

Notes: This test seemed particularly good as a means of showing the subject's method of attack and general efficiency. However, we were unable to make any use of the results because of the difficulty in evaluating in terms of standardized performances. An exhaustive study was made of the performances in an attempt to grade them on a finer

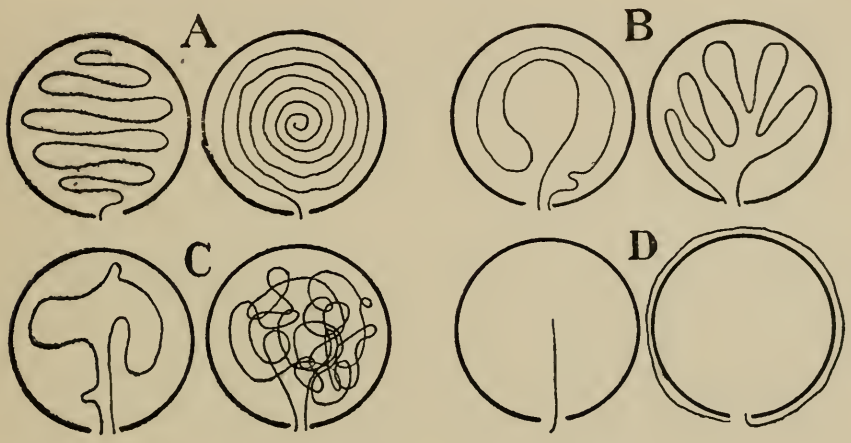


Fig. 14.—Ball and Field Evaluation Types.

scale than that used by Mr. Terman. The numbers bunched so overwhelmingly on the A and C types that the conclusion seemed quite definite that when the instructions were understood, a child either indicated an adequate plan or simply covered the field in a haphazard way, which practically necessitates its evaluation as a plus or minus test. Mr. Terman makes no provision for type D; probably it was not necessary because of his instructions, which allowed for explaining until the child clearly understood what was wanted. But with our method of making instructions uniform, a large group of subjects failed entirely to understand what they were to do, which resulted in type D, about which it is impossible to say anything except that the instructions

were inadequate. The difficulties of some subjects in controlling their pencils which resulted in a performance obviously not as good as their understanding of the problem, would further suggest the undesirability of making too fine a grading of the results.

The Binet-Simon Scale

The Town translation of the 1911 revision of Binet and Simon's "A Method of Measuring the Development of the Intelligence of Young Children," was followed in giving and evaluating the Binet tests. In order to get a uniform body of material, all the tests for seven through 15 years and as many lower tests as necessary were given to each subject. A uniform order was followed, planned to avoid monotony and discouragement by alternating the hard and easy tests and scattering throughout the series the tests that require the subject to handle material. The instructions were taken verbatim from the Town Appendix, except in the instances listed below. The subject's responses were recorded in full, and were listed according to uniform numbering and lettering in order to simplify their identification for evaluation. 'Distinguishing between Morning and Afternoon,' 'Pointing to the Right Hand and Left Ear,' 'Naming Colors,' 'Counting Pennies,' and 'Repeating Syllables,' were checked plus as they were given unless the subject made an error, when the procedure was noted. No other tests were scored at the time of giving.

Since few of the children had a fluent and easy command of English, an even larger number of incomplete answers than is usual resulted. In order not to penalize the children unduly for halting, incomplete answers, and to keep the test procedure standard, the follow up questions to be used were specified and noted when used. No questions were asked which might suggest the desired response or convey to the subject the fact that his first answer was incorrect.

The results were scored and the mental age figured some time after the test had been given, first by the tester and then by a second person. The final scoring was entered on a printed blank, but the original records were taken on sheets of plain paper, which were filed with the subject's other records.

Binet's discussion of each test was made into a rule for its evaluation, and his examples listed as illustrations. Ambiguous responses were discussed by all the testers: as decisions were reached they were listed in the instructions, in order to insure uniform scoring. 'Three Given Words in One Sentence' and 'Comparing Two Objects from Memory' caused the most difficulty, and after all the testing was done the rules for their evaluation were again defined and the results rescored. In amplifying and arranging our rules we had the benefit of a similar piece of work which was being done at the Laboratory of Social Hygiene at Bedford Hills, and with a few exceptions the instructions are identical.

The mental age was figured by taking as the basal year the highest year at which all five tests were passed and adding two-tenths for each test passed above the basal year. No account was taken of the scatter of tests below the basal year, and if all five tests of a year were minus, no tests above it were counted.

Since our rules attempted to follow exactly Binet's instructions, they are not given here, except for those tests where the Town Appendix was found to be incomplete or failed to adequately prescribe the procedure. The procedure for these tests follows.

Test No. 29. VII Years. Counting Stamps.

Since a specified procedure is not prescribed in the appendix, the following method was decided upon. Show the subject three two-cent and three one-cent stamps mounted on a card; point to a two-cent and then to a one-

cent stamp, saying, "How much does this cost?" If the subject does not know, tell him their values. Then say, "How much would all these cost?"

Test No. 31. VIII Years. Comparing Two Objects from Memory.

The order of giving the questions was altered. 'Fly and Butterfly' were asked first and 'Paper and Cloth' last. 'Cloth' was substituted for 'cardboard.' The change in order was made because the gain in convenience for the combination seemed to more than offset a possible alteration of the original test. Since many of our Jewish group were unfamiliar with 'cardboard,' some change in this part of the test was desirable, and the Yerkes form was adopted.

Test No. 33. VIII Years. Omission from Pictures.

If the subject did not understand the word 'missing,' the question was repeated, substituting the word 'gone'; 'missing' was an unfamiliar word to many of the group.

Test No. 34. VIII Years. Giving the Date.

Say "What day is it to-day? What date is it?" If the answer is the day of the month only, say, "Give me the whole date." If the year is not given, "And the year." Note the questions asked. This procedure was adopted because, although it seemed to be a marked departure from that prescribed in the Appendix, it does follow the suggestion made by Binet as to the difficulty of getting the subjects to give the whole date, even when they know it.

Test No. 36. IX Years. Making Change.

Say to the subject, "Suppose you were the storekeeper and this is your money, and I was buying this box which

costs six cents, and gave you this money (present quarter), how much change would you give me?" Hold out hand and add, "Give it to me." The difference in money necessitates some departure in method from that prescribed by Binet, and we adopted the above in preference to the Town because it is more generally used. Since the Appendix does not give the exact procedure, we prescribed this wording.

Test No. 38. IX Years. Naming Money.

(A) Show the subject successively: a penny, a dime, a quarter, a nickel, a half-dollar, and a one dollar bill, saying in each case, "What is this?" Then say, "What other bills are there besides *one* dollar bills?" (B) If he mentions, three, four, etc., dollar bills, ask "Did you ever see a three or four, etc., dollar bill?" If he answers, "No," ask, "Did you ever see a two dollar bill?" (C) In case of a single omission in naming bills, repeat this part of the test later in the series. Corrections of errors made under (A) in either (B) or (C), give plus for the test. The test was used in this form instead of showing all the bills to the subject because of the impracticability of keeping the necessary amount of money for several testers in a public school building.

Test No. 45. X Years. Using Three Given Words in One Sentence.

Write the words, "Brooklyn, money, river." Show the paper to the subject and read the words aloud, then say, "I want you to make a sentence and use in it these three words, "Brooklyn, money, river."

The use of 'Brooklyn' in place of 'Paris' is not considered a change. 'Money' was used in place of 'fortune' because to our group with their limited knowledge of English fortune means luck or chance. We replaced the general directions of the Appendix by this exact procedure.

Test No. 48. XII Years. Giving Words for Three Minutes.

Say, "I want you to say just as many words as you can in three minutes. Don't say the same word more than once. Some people say as many as two hundred. Any word will do, such as table, skirt, brook, clouds, dog, pin, happy, courage. Now go ahead and say as many as you can." If the subject stops, assuming that enough words have been given, at the end of the half-minute period say "Go on, please." If he gives more than three consecutive figures, say, "Don't count any more."

While Binet does not say that he required different words, his discussion indicates that he did. Although no examples are given in the Appendix procedure, they are called for in Binet's procedure. Since a complete list of words is not prescribed, the Yerkes examples were used.

Test No. 50. XII Years. Putting Together Dissected Sentences.

Say, "I want you to put these words into their proper order, and find the sentence which they make. Use all the words there are and no others."

The instructions in the Appendix were changed because their wording seemed too difficult for the understanding of the children in our groups.

Test No. 52. XV Years. Giving Rhymes.

Say, "Do you know what I mean when I say that a word rhymes with another word? Two words that rhyme are two words which end in the same sound. Like rat, hat, cat, or button, mutton. Do you see? Now tell me all the words you can think of that rhyme with defender; like pretender, contender, suspender." A two-syllable rhyme was accepted.

The Town procedure was altered in an attempt to reproduce the test situation called for by the French instruc-

tions even at the expense of an exact translation. In colloquial English pumpkin and napkin do not rhyme as they do in French. 'Obeir' is a three-syllable word of considerable difficulty. 'Defender' was selected as a word approaching it in difficulty. Although an easier word probably should have been selected, it is interesting to note that we asked a large number of children for rhymes for 'obey' as a check, and the results were no better than those obtained for defender.

Tests No. 18 and 53. V and XV Years. Repeating Syllables.

The following sentences were used: "His name is John. It is a very fine day." "It is not necessary to hurt the poor little birds. It is night and all the world rests in sleep."

The Yerkes sentences were used instead of the Binet because they seemed more suitable to the test. "My name is Charley. Oh, the naughty dog!" has an affective element which might distract the child's attention from a literal reproduction. The sixteen-syllable sentence in the Appendix is awkward in phraseology, which increases the difficulty of repetition beyond that of the sentence given in the translation of Binet's instructions.

Yerkes-Bridges Point Scale

The children were also rated by the Yerkes-Bridges Point Scale. The material for the scale is so largely identical with that for the Binet that it was a simple matter to score our detailed record for both scales. Our primary interest was to obtain norms for the Binet Scale based on an accurate interpretation of the original Binet instructions and a carefully standardized procedure. Therefore wherever the Binet and Yerkes procedure are opposed to each other, the preference was given to the Binet Scale. This necessitated certain alterations of the instructions given in

Yerkes Bridges and Hardwick's, "A point Scale for Measuring Mental Ability."

Tests where the two Scales overlap were arranged by listing all the material for both as one test, lettering each part and recording the responses under their proper letters. It was then easy to separate the portions of the test to be scored for Binet from those to be scored for Yerkes.

Yerkes allows somewhat more latitude in giving instructions than Binet ("If one form of expression or explanation is not intelligible to the child, care should be taken that a clear understanding is established by some variation of the form of statement"). This was met by giving the instructions first in the strict Binet form, recording the response, and then asking a specified follow up question, phrased so as to complete the instructions called for by Yerkes. The response to these additional questions was then recorded and used in scoring for the Point Scale. In some tests it was found impossible to add the exact Point Scale instructions to the Binet without altering the test, which resulted in the following departures from the Yerkes instructions. While the legitimacy of using the Point Scale in this way may be questioned, a study of the listed differences indicates that with the exception of a changed time limit the differences are no greater than those that would be permitted by the quotation given above. Considering differences in the groups examined, our norms follow those published by Yerkes very closely.

Test 4. Memory Span for Digits. The Binet instructions for seven digits were used: "Now I'm going to say seven numbers. Listen and repeat them exactly." Here the subject has the advantage of knowing how many numbers he is asked to remember.

Test 7. Description of Three Binet Pictures. The instructions used were: Say, "What is this?" In case of no response, follow by, "Tell me what you see there." The Yerkes form, "Please look at this picture and tell me about

it," might be considered more likely to result in description and interpretation than the Binet form.

Test 16. Drawing Designs from Memory. The subject was shown the card for ten seconds instead of fifteen.

Test 18. Construction of Sentences. The words were presented to the children in a slightly different order from that called for in the Yerkes instructions.

1.	For	An	The	2.	To	Asked	Spelling
	At	Hour	Early		My I	Teacher	
	We	Country	Started		Correct	My	

3.	A	Defends	His
	Dog	Good	
	Master	Bravely	

CHAPTER IV

TEST NORMS

In presenting norms, their exact meaning and the limitations of their possible uses demand emphasis. For interpretation an individual score must always be related to the appropriate norm. The size of the score in itself does not indicate whether the performance was good or poor—that is, the numerical values have not been translated into terms of a scale involving a general assumption as to the quality of the performance. Where time is the value, a low score generally indicates a good performance, while in many of the tests excellence is indicated by a high score. Further, in some tests the range of scores is very large, while in others it is limited by the number of steps in the test performance. No assumption can be made directly from the numerical score, without referring back to the norms or the test material. Even in the Maturity Scale, the standings represent simply the individual's relative position with reference to the average of the particular group.

A further point must be made regarding the nature of the norms. A norm should never be used as an absolute standard for rating a given individual without consideration of what it represents. Those here presented are the reactions to the tests of a random sampling of Jewish children ranging from nine through thirteen years. Other groups yielding norms which vary from those of the present group may also represent good sampling. These values, then, must not be taken to represent the normal performances of all children. With these facts in mind, the norms

may be used for work with individual children of other groups. It is only essential to consider the characteristics of the group, and to use the norms as points of reference rather than as absolute standards for all classes of children.

For the convenience of users of the tests described, the norms are given in two forms:

I. The mean and the standard deviation with their probable errors are given for each age.

II. The regression equation of the performance in each test on age is given, together with the standard deviation of the measurements about the regression line.

I

The mean is the arithmetic average of the scores in a test, made by children of each age. Children who are included in the nine year group are those who have passed their ninth but who have not yet reached their tenth birthday: consequently the average for each age group falls at the mid-year; that is, the test norms are for 9.5 years, 10.5 years, etc. The standard deviation gives an indication of the amount of variability found in each age group. The probable errors of the means and standard deviations are given to facilitate the comparison of the groups which we have studied with groups which may be the subject of future investigation. The mean and standard deviation of the indefinitely large population of which we have measured a relatively small sample may be safely placed within a range three times the probable error above and below the observed mean and standard deviation.

The norms in this form are convenient for instant reference. In estimating the significance of the difference of an individual child's score from the norm for a given age, the observed difference should be related to the standard deviation. This is done by dividing the observed difference by the standard deviation. The resulting ratio is sometimes

called the *standing* in the test. It may be said that standings of ±.8 are large enough to indicate a variation from normal worth noting; those as large as + 2 and — 4 rarely occur. Large negative are more common than large positive standings, since the distribution in most tests is negatively skewed. In addition to relating the child's score to the norm, the *standing* offers a means of comparing the individual's performances in various tests. In using standings, it should be borne in mind that their significance depends upon the form of the distribution of scores in the test. A child's *standing* for any desired group of tests may be obtained by adding or averaging his standings in individual tests.

II

The regression of scores on age gives more satisfactory norms than those obtained by using the arithmetic mean. This is due to the fact that the regression equation neutralizes the erratic effect of sampling on the individual norms. The regression equation also permits the stating of the norm for as specific an age as the circumstances demand. When using the norms described under I, a child on his tenth birthday must be compared with children of age 9.5 or else of age 10.5, in either case a half year removed. In tests where improvement with age is rapid, the difference caused by this half year may be important enough to cause serious error. The mean for *any* specific age, however, may be obtained from the regression equation by substituting this age for *age* in the equation and solving. The result is the most probable mean score for that age that can be obtained from our data.

The standard deviation of the measures about the regression equation is to be taken as the standard deviation of variability for every age. This is better than using any

specific standard deviation since the erratic effect of sampling is again neutralized.*

The *standing* for any child in a test is computed on the basis of the norms from the regression equation just as it is computed from the observed norms. Standings based on the regression equation will be more satisfactory in the long run.

For certain tests, it seemed desirable to combine two separate measures of excellence of performance, such as speed and accuracy, into a single quantitative value or index. We wished to make this combination on something more than an *a priori* basis. Consequently we have chosen to unite them in such a way that we might gain maximum discrimination between the mean indices for the ages under investigation. We have set up our indices in the form:

$$I=xA+yB+z$$

Where I is the index, A and B are the measurements to be combined, and x, y, and z are constants so selected that there shall be a minimum overlapping of the indices of the children of different ages.

This form of index gave misleading results in certain tests, notably the Substitution test, where the rectilinearity of the regressions between variables seemed questionable. In such tests no index was used.

TABLE 1.—AGE OF TEST GROUPS

			Boys		
Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	9.53±.020	10.64±.019	11.64±.022	12.56±.025	13.63±.024
S. D.....	.207±.01	.200±.01	.236±.02	.265±.02	.257±.02
			Girls		
Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	9.64±.018	10.59±.021	11.58±.018	12.60±.025	13.59±.025
S. D.....	1.91±.01	.220±.01	.188±.01	.258±.02	.262±.02

* The regressions appear sufficiently homoscedastic to justify the use of the standard deviation in this way.

TABLE 2.—CART CONSTRUCTION

Time in Seconds

BOYS

Regression equation 344.88 − 16.28 Age. σ 108.00

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	193 ±11	174 ±12	164 ±12	106. ±6.4	139. ±8.9
S. D.....	113.0± 7.8	123.0± 8.4	126.0± 8.8	65.4±4.5	92.2±6.3

GIRLS

Regression equation 381.74 − 12.55 Age. σ 129.69

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	254 ±11	251 ±13	236 ±13	245 ±13	195 ±12
S. D.....	113.0± 7.9	136.0± 9.5	133.0± 9.3	132.0± 9.0	128.0± 8.6

TABLE 3.—CART CONSTRUCTION

SCORE 1+2

BOYS

Regression equation 13.26+.984 Age. σ 4.31

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	22.67±.48	23.65±.50	24.79±.41	25.52±.37	26.69±.31
S. D.....	4.88±.34	5.15±.35	4.17±.29	3.76±.26	3.23±.22

GIRLS

Regression equation 8.79+1.61 Age. σ 4.98

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	19.91±.55	21.13±.50	22.17±.53	23.84±.48	24.34±.35
S. D.....	5.49±.38	5.08±.36	5.39±.38	5.02±.34	3.69±.25

TABLE 4.—CART CONSTRUCTION

SCORE 1

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.–13.9
Mean....	17.88±.28	18.04±.25	18.68±.17	18.98±.12	18.84±.17
S. D.....	2.83±.20	2.55±.17	1.75±.12	1.28±.09	1.78±.12

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	16.71±.38	17.28±.31	17.45±.36	18.45±.18	18.38±.16
S. D.....	3.81±.27	3.12±.22	3.67±.26	1.85±.13	1.70±.11

TABLE 5.—CART CONSTRUCTION

SCORE 2

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	4.58±.34	5.61±.36	6.11±.32	6.54±.32	7.82±.25
S. D.....	3.53±.24	3.73±.25	3.21±.23	3.30±.23	2.66±.18

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	3.20±.30	3.85±.34	4.72±.35	5.39±.37	5.96±.26
S. D.....	3.04±.21	3.48±.24	3.52±.25	3.81±.26	2.76±.19

TABLE 6.—NARRATIVE PICTURES

Score in Percent

BOYS

Regression equation 7.52+4.34 Age. σ 19.10

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	48.3±1.9	51.8±1.9	56.2±2.1	64.8±1.9	65.9±1.5
S. D.....	19.1±1.3	19.3±1.3	21.0±1.5	19.7±1.3	15.8±1.1

GIRLS

Regression equation 17.71+3.66 Age. σ 19.61

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	56.8±1.8	57.9±2.3	64.5±1.5	62.5±1.9	72.4±1.9
S. D.....	17.6±1.2	23.0±1.6	15.4±1.1	19.2±1.3	20.3±1.4

TABLE 7.—IDENTIFICATION OF FORMS

Score in Percent

BOYS

Regression equation 44.93+1.98 Age. σ 17.90

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	63.3±1.9	65.1±1.8	71.0±1.7	70.1±2.5	71.9±1.7
S. D.....	20.0±1.4	18.8±1.3	17.5±1.2	25.5±1.8	18.0±1.2

GIRLS

Regression equation 31.96+2.80 Age. σ 19.60

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	57.9±1.8	57.7±1.8	64.9±1.9	61.5±1.5	67.0±1.8
S. D.....	18.5±1.3	18.5±1.3	19.3±1.4	15.8±1.2	19.2±1.3

TABLE 8.—INSTRUCTION BOX

Number of Correct Moves

BOYS

Regression equation 2.64±.138 Age. σ 1.49

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	3.96±.15	3.57±.15	4.58±.13	4.77±.14	4.14±.14
S. D.....	1.55±.11	1.51±.10	1.37±.09	1.39±.10	1.41±.10

GIRLS

Regression equation 2.09+.170 Age. σ 1.58

Age.....	9.0–9.9	10.–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	3.70±.16	3.94±.15	4.00±.18	4.24±.12	4.48±.15
S. D.....	1.59±.11	1.55±.11	1.85±.13	1.22±.08	1.53±.10

TABLE 9.—NEEDLE THREADING

Number of Successes

BOYS

Regression equation .301 Age. σ 1.21

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	3.08±.11	3.02±.13	3.13±.14	3.92±.11	4.29±.08
S. D.....	1.11±.08	1.38±.09	1.41±.10	1.08±.07	.78±.05

GIRLS

Regression equation 1.54+.22 Age. σ .937

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	3.37±.11	4.17±.09	4.02±.09	4.12±.08	4.46±.07
S. D.....	1.07±.07	.93±.06	.93±.06	.87±.06	.78±.05

TABLE 10.—NAIL DRIVING

Distance in Sixteenths of an Inch

BOYS

Regression equation 28.10+2.34 Age. σ 14.70

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	51.1±1.5	49.1±1.5	58.5±1.5	56.96±.90	61.1±1.3
S. D.....	15.6±1.1	15.6±1.1	15.4±1.1	9.20±.64	13.20±.86

GIRLS

Regression equation 14.91+2.93 Age. σ 14.43

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	41.2±1.2	47.6±1.6	53.0±1.6	45.6±1.4	57.10±.97
S. D.....	11.60±.81	16.6±1.2	16.2±1.1	14.10±.96	10.20±.68

TABLE 11.—PICTURE COMPLETION INDEX

BOYS

Regression equation 9.49+.183 Age. σ.564

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	11.16±.02	11.45±.03	11.65±.02	11.89±.02	11.88±.02
S. D.....	.54±.02	.59±.02	.50±.02	.53±.02	.53±.02

GIRLS

Regression equation 10.46+.100 Age. σ.430

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	11.39±.01	11.53±.02	11.79±.02	11.80±.02	11.83±.02
S. D.....	.33±.01	.43±.01	.38±.01	.43±.01	.41±.01

Since individual indices were computed only from *standings* for score and time, the means for indices based on scores were obtained by substituting the mean score and mean time for each age in the index formula (see page 41). The standard deviation was obtained from the following formula,

$$\sqrt{x^2\sigma^2_{S9.5} + y^2\sigma^2_{T9.5} - 2xyr_{S9.5\ T9.5}\ \sigma_{S9.5}\ \sigma_{T9.5}}.$$

Since the last expression was of negligible size the formula was used in the form

$$\sqrt{x^2\sigma^2_{S9.5} + y^2\sigma^2_{T9.5}}.$$

This procedure was checked by obtaining the values from the actual indices figured from the score and time for one age and was found to be entirely legitimate.

TABLE 12.—PICTURE COMPLETION TIME IN SECONDS

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	278.4±9.1	221.9±7.8	209.9±7.9	196.5±8.4	204.9±9.0
S. D.....	93.1±6.4	80.7±5.5	80.0±5.6	85.9±5.9	93.2±6.3

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	269.0±9.9	270 ±11	256.8±8.5	236.2±9.4	231.9±9.2
S. D.....	99.4±7.0	112.0± 7.8	86.7±6.1	105.0±7.2	96.7±6.5

TABLE 13.—PICTURE COMPLETION SCORE

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	8.94±.33	9.82±.39	11.06±.32	12.5 ±.34	12.67±.33
S. D.....	3.43±.24	4.01±.27	3.27±.23	3.48±.24	3.41±.23

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	7.59±.29	9.04±.38	11.40±.35	10.14±.38	11.42±.36
S. D.....	2.92±.20	3.86±.27	3.59±.25	3.95±.27	3.77±.25

TABLE 14.—PROBLEM BOX

Score

BOYS

Regression equation −1.27+.370 Age. σ 1.31

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	1.96±.12	2.74±.13	3.22±.12	3.66±.13	3.38±.12
S. D.....	1.25±.08	1.33±.09	1.22±.08	1.32±.09	1.25±.08

GIRLS

Regression equation −.317+.286 Age. σ 1.37

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	2.42±.12	2.74±.13	3.22±.14	3.25±.13	3.64±.14
S. D.....	1.25±.08	1.40±.09	1.45±.10	1.33±.09	1.43±.10

TABLE 15.—PROBLEM BOX

Time in Seconds for Successful Performances

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	158 ±13	119 ±11	80.0±9.0	64.0±7.6	67.0±6.4
S. D.....	108.0± 9.0	113.7± 7.7	93.9±6.4	78.7±5.4	66.8±4.5
Percent of successes	66	98	98	96	98

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	132 ±11	106.0±9.1	94.0±8.7	95.0±9.8	84.0±9.4
S. D.....	98.6± 7.7	84.0±6.4	84.9±6.1	95.8±6.9	95.7±6.6
Percent of successes	74	78	88	92	94

TABLE 16.—MEMORY FOR OBJECTS

Score in Percent

BOYS

Regression equation 67.33+.377 Age. σ 11.70

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	68.3 ±1.2	73.08±.99	74.0 ±1.3	71.67±.97	72.0±1.1
S. D.....	12.00± .83	10.30±.70	13.20± .92	9.94±.68	11.3± .77

GIRLS

Regression equation 61.26+1.28 Age. σ 9.94

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	72.8 ±1.5	74.1 ±1.3	75.6 ±1.0	78.5 ±1.1	77.9 ±1.2
S. D.....	11.60± .81	13.40± .94	10.20± .71	11.20± .76	12.40± .83

TABLE 17.—KNOX CUBES

Memory Span

BOYS

Regression equation 3.88+.142 Age. σ 1.64

Age	11.0–11.9	12.0–12.9	13.0–13.9
Mean	5.32±.17	5.42±.17	5.78±.14
S. D.	1.76±.12	1.77±.12	1.45±.10

GIRLS

Regression equation −2.65+.680 Age. σ 1.47

Age	11.0–11.9	12.0–12.9	13.0–13.9
Mean	5.60±.14	5.68±.14	6.44±.15
S. D.	1.46±.10	1.44±.10	1.55±.10

TABLE 18.—HEALY "A"

Score

BOYS

Regression equation −.349+.287 Age. σ 1.36

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	2.08±.13	3.06±.13	3.10±.13	3.32±.14	3.38±.13
S. D.	1.39±.09	1.38±.09	1.31±.09	1.49±.10	1.36±.09

GIRLS

Regression equation .159+.245 Age. σ 1.33

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	2.54±.13	2.64±.13	3.08±.13	3.06±.13	3.70±.12
S. D.	1.33±.09	1.40±.09	1.34±.09	1.35±.09	1.27±.08

TABLE 19.—HEALY "A"

Time in Seconds for Successful Performances

BOYS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	181 ±13	108.0±8.9	109.0±9.4	118 ±12	100.0±9.1
S. D.	120.0± 8.9	87.6±6.3	92.3±6.6	121.8± 8.4	94.3±6.5
Percent of successes	82	88	90	96	96

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	153 ±16	150 ±12	118 ±10	149 ±13	89.0±7.7
S. D.	140 ±11	110.1± 8.4	99.2± 7.2	136.0± 9.4	78.2±5.4
Percent of successes	72	78	86	94	94

TABLE 20.—HEALY "B"

Time in Seconds for Successful Performances

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	205±16	178 ±14	161 ±11	151 ±13	182±15
S. D.....	129±11	123.0± 9.6	100.9± 7.5	124.5± 9.3	145±10
Percent of successes	62	74	82	80	80

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	207±16	196±16	152 ±12	199 ±15	146.0±8.1
S. D.....	119±12	117±11	106.3± 8.4	140±11	77.9±5.9
Percent of successes	52	48	72	76	84

TABLE 21.—CARD SORTING TIME IN SECONDS

BOYS

Regression equation 95.28 − 3.74 Age. σ 9.35

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	61.8 ±1.1	55.27±.94	49.94±.79	47.63±.84	44.94±.68
S. D.....	10.90±.75	9.77±.66	8.00±.56	8.65±.60	7.06±.48

GIRLS

Regression equation 83.16 − 2.92 Age. σ 9.97

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	54.44±.91	51.9 ±1.3	51.2 ±1.1	46.80±.85	42.60±.63
S. D.....	9.18±.64	13.00± .91	11.10± .78	8.85±.60	6.62±.44

TABLE 22.—CARD SORTING ACCURACY IN PERCENT

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	97.70±.34	98.37±.32	98.49±.27	98.30±.22	97.78±.23
S. D.....	3.62±.24	3.39±.23	2.83±.19	2.29±.16	2.40±.16

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	99.32±.10	99.19±.15	99.10±.13	98.93±.14	99.33±.11
S. D.....	1.08±.07	1.61±.11	1.34±.09	1.51±.10	1.15±.08

TABLE 23.—CANCELLATION INDEX

Boys

Regression equation 9.44+.187 Age. σ .569

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	11.09±.04	11.50±.03	11.68±.03	11.73±.03	11.92±.02
S. D.....	1.00±.03	.57±.02	.57±.02	.67±.02	.51±.02

Girls

Regression equation 8.62+.259 Age. σ .626

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	11.03±.04	11.46±.04	11.56±.03	11.80±.03	12.10±.03
S. D.....	.80±.03	.99±.03	.76±.02	.64±.02	.58±.02

See note on Picture Completion Index, p. 81

TABLE 24.—CANCELLATION TIME IN SECONDS

Boys

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	327 ±12	303.7±6.7	281.4±6.8	261.2±7.8	247.7±5.9
S. D.....	122.0± 8.4	69.2±4.7	69.0±4.8	80.4±5.5	61.1±4.2

Girls

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	319.4±8.4	285 ±11	287.7±7.3	257.9±6.9	227.4±6.1
S. D.....	84.9±5.9	113.0± 7.9	73.7±5.2	72.0±4.9	63.8±4.3

TABLE 25.—CANCELLATION ACCURACY IN PERCENT

Boys

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	74.2±1.9	83.2 ±1.1	84.3 ±1.1	80.7 ±1.3	84.22±.99
S. D.....	19.3±1.3	11.00± .75	11.20± .78	13.30± .92	10.30±.70

Girls

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.09
Mean....	75.4±1.5	80.7±1.7	84.3±1.6	85.0 ±1.1	87.5 ±1.0
S. D.....	15.1±1.1	17.2±1.2	16.1±1.1	11.30± .77	10.70±.72

TABLE 26.—SUBSTITUTION TIME IN SECONDS PAGES 1–3

BOYS

Regression equation 968.62 −42.89 Age. σ 114.10

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	582 ±14	513 ±12	456.3±9.4	430.2±9.6	409.6±7.8
S. D.....	140.0± 9.7	121.0± 8.2	95.1±6.7	98.9±6.8	80.9±5.5

GIRLS

Regression equation 908.11 −37.98 Age. σ 113.01

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	557 ±13	483 ±12	480 ±12	432.8±9.5	390.2±6.3
S. D.....	134.0± 9.4	120.0± 8.4	124.0± 8.7	98.4±6.7	65.8±4.4

TABLE 27.—SUBSTITUTION TIME IN SECONDS PAGE 1

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	248.8±7.1	213.3±4.4	194.8±4.5	174.8±3.4	168.1±2.7
S. D.....	73.1±5.0	45.5±3.1	46.0±3.2	35.2±2.4	28.3±1.9

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	233.5±5.4	206.2±5.9	191.3±5.3	176.0±4.1	161.2±3.0
S. D.....	54.5±3.8	59.5±4.2	54.1±3.8	42.5±2.9	31.8±2.1

TABLE 28.—SUBSTITUTION TIME IN SECONDS PAGE 2

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	179.0±4.5	164.8±4.4	140.8±2.9	138.4±3.9	130.4±3.0
S. D.....	46.3±3.2	45.4±3.1	29.5±2.1	39.8±2.7	31.5±2.1

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	174.8±4.9	148.5±3.9	154.9±4.5	136.9±3.2	121.3±2.4
S. D.....	49.1±3.4	39.3±2.8	46.8±3.3	33.3±2.3	25.4±1.7

TABLE 29.—SUBSTITUTION TIME IN SECONDS PAGE 3

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	154.1±4.2	136.4±3.9	120.7±3.1	117.0±3.3	112.5±2.7
S. D.....	43.5±3.0	40.5±2.8	31.2±2.2	34.1±2.4	28.1±1.9

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	148.6±4.0	128.1±3.2	131.6±4.4	119.9±3.4	107.6±2.5
S. D.....	39.9±2.8	32.3±2.3	44.6±3.1	35.6±2.4	26.1±1.7

TABLE 30.—SUBSTITUTION TIME IN SECONDS PAGE 4

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	148.1±6.1	130.4±3.8	114.5±2.6	107.6±2.8	114.1±4.2
S. D.....	62.8±4.3	39.4±2.7	26.8±1.9	28.8±2.0	43.2±2.9

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	141.1±5.0	133.0±9.0	133.9±5.5	121.7±4.3	114 ±15
S. D.....	51.0±3.6	91.9±6.4	55.6±3.9	44.4±3.0	40.6± 2.7

TABLE 31.—SUBSTITUTION ACCURACY IN PERCENT PAGE 4

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	91.3 ±1.4	92.4 ±1.2	94.77±.73	93.75±.90	92.6 ±1.1
S. D.....	14.00± .97	12.10± .82	7.37±.52	9.27±.64	11.60± .79

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	93.96±.96	91.2 ±1.4	93.0 ±1.1	92.8 ±1.2	94.2 ±1.0
S. D.....	9.61±.67	13.80± .95	11.20± .78	12.50± .85	10.90± .73

TABLE 32.—DIGITS

Memory Span

BOYS

Regression equation 5.26+.183 Age. σ 1.03

Age.....	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean.....	7.04±.08	7.40±11	7.26±.10	7.84±.10
S S.....	.89±.06	1.17±.08	1.00±.07	1.03±.07

GIRLS

Regression equation 4.68+.226 Age. σ 1.16

Age.....	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean.....	6.96±.11	7.52±.11	7.52±.11	7.70±.11
S. D.....	1.13±.08	1.20±.08	1.12±.08	1.08±.07

TABLE 33.—STEADINESS

Right-hand Score

BOYS

Regression equation 128.46 − 5.23 Age. σ 16.98

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	82.8 ±1.2	72.8±1.6	74.2±1.5	59.9±1.6	62.3±1.6
S. D.....	12.12± .81	17.2±1.1	15.5±1.0	17.0±1.2	16.8±1.1

GIRLS

Regression equation 119.72 − 5.22 Age. σ 17.71

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	67.7±1.7	69.3±1.5	66.2±1.7	57.7±1.6	47. 4±1.4
S. D.....	18.3±1.2	16.3±1.1	17.4±1.2	17.4±1.2	14.54±.97

TABLE 34.—STEADINESS

Left-hand Score

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	91.1 ±1.0	83.1 ±1.3	83.5 ±1.4	70.7±1.6	70.2±1.6
S. D.....	10.74± .72	13.88± .93	14.40± .96	16.5±1.1	16.5±1.1

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	81.0±1.5	77.4±1.5	75.6±1.3	67.2±1.7	58.5±1.5
S. D.....	15.5±1.0	15.8±1.1	13.26± .89	17.9±1.2	15.6±1.0

TABLE 35.—STRENGTH OF GRIP IN KILOGRAMS

Right Hand

BOYS

Regression equation −10.73+2.63 Age. σ 4.11

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.09	13.0–13.9
Mean....	15.51±.24	16.70±.39	21.16±.39	23.23±.33	25.93±.61
S. D.....	2.53±.17	4.12±.28	4.06±.28	3.45±.23	6.44±.43

GIRLS

Regression equation −1.39+1.68 Age. σ 4.44

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	14.01±.25	15.06±.24	17.49±.29	19.82±.42	23.97±.44
S. D.....	2.60±.17	2.57±.17	3.08±.21	4.38±.29	4.60±.31

TABLE 36.—STRENGTH OF GRIP IN KILOGRAMS

Left Hand

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	14.11±.22	15.19±.27	19.07±.40	20.29±.31	22.91±.58
S. D.....	2.32±.16	2.81±.19	4.14±.28	3.30±.22	6.13±.41

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	11.99±.22	13.33±.25	15.38±.25	17.54±.43	21.12±.39
S. D.....	2.32±.16	2.62±.18	2.63±.18	4.54±.30	4.05±.27

TABLE 37.—STRENGTH OF GRIP IN KILOGRAMS

Average of Left and Right Hands

BOYS

Age.....	9.0–9.9	10.0–01.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	14.81±.22	16.05±.27	20.11±.38	21.73±.31	24.42±.59
S. D.....	2.27±.15	2.81±.19	3.97±.27	3.22±.22	6.21±.42

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	13.00±.22	14.20±.23	16.44±.26	18.68±.41	22.55±.40
S. D.....	2.28±.15	2.46±.16	2.75±.18	4.34±.29	4.16±.28

TABLE 38.—BINET

Mental Age

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	9.06±.05	9.56±.06	9.98±.05	10.19±.06	10.43±.06
S. D.....	.51±.03	.66±.05	.56±.04	.68±.05	.64±.04

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	8.98±.07	9.38±.08	10.02±.10	10.10±.09	10.65±.07
S. D.....	.76±.05	.87±.06	.98±.07	.93±.06	.72±.05

TABLE 39.—BINET TESTS

Percent of Successes for Individual Tests

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
VIII					
Test 1...	96	100	100	98	100
2...	86	98	98	98	100
3...	78	94	88	92	94
4...	66	96	98	96	96
5...	100	98	100	100	100
IX					
Test 1...	80	84	96	90	96
2...	14	27	32	26	52
3...	44	63	74	88	86
4...	76	92	84	92	84
5...	66	80	88	96	94
X					
Test 1..	70	82	92	80	86
2...	6	16	28	46	40
3...	22	33	42	54	72
4...	2	14	34	39	36
5...	56	51	74	74	74
XII					
Test 1...	26	6	30	20	26
2...	40	35	53	49	56
3...	34	49	74	76	78
4...	14	39	40	62	78
5...	12	39	58	56	68
XV					
Test 1...	66	72	76	86	84
2...	0	26	23	23	14
3...	4	0	4	0	4
4...	14	16	16	50	40
5...	0	5	4	6	14

The tests are listed in the order given in the Town Appendix

TABLE 40.—BINET TESTS

Percent of Successes for Individual Tests

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
VIII					
Test 1...	96	96	98	100	100
2...	96	96	100	98	100
3...	76	84	96	84	100
4...	76	90	100	94	98
5...	98	98	100	100	100
IX					
Test 1...	84	78	88	90	92
2...	28	32	36	55	70
3...	22	44	67	61	92
4...	84	88	98	94	100
5...	78	80	90	90	98
X					
Test 1...	60	74	88	80	76
2...	14	12	29	33	58
3...	20	22	44	61	74
4...	8	20	29	43	74
5...	40	48	67	63	76
XII					
Test 1...	28	34	30	35	26
2...	22	10	33	31	50
3...	34	50	54	65	82
4...	12	28	44	65	82
5...	20	34	61	53	74
XV					
Test 1...	56	58	79	84	84
2...	0	14	15	27	22
3...	2	6	13	6	20
4...	10	14	19	23	22
5...	0	0	9	6	16

The tests are listed in the order given in the Town Appendix

TABLE 41.—YERKES POINT SCALE

Total Score

BOYS

Regression equation 11.05+4.73 Age. σ 8.76

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	53.80±.77	62.28±.88	67.40±.90	71.46±.94	73.88±.80
S. D.....	8.06±.54	9.11±.62	9.37±.63	9.81±.66	8.39±.69

GIRLS

Regression equation 10.33+4.85 Age. σ 10.62

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean....	54.86±.90	58.4 ±1.1	67.7 ±1.1	71.7 ±1.0	79.14±.83
S. D.....	9.43±.63	11.48± .77	11.19± .77	10.87± .74	8.72±.58

TABLE 42.—YERKES POINT SCALE

Mean Score for Individual Tests

BOYS

						Total	
Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9	Mean	σ
Test 1.....	2.9	3.0	3.0	3.0	3.0	2.99±.01	.15±.00
2.....	3.7	3.8	3.9	3.9	3.9	3.83±.02	.50±.02
3.....	2.9	3.0	3.0	3.0	3.0	2.98±.01	.13±.00
4.....	4.4	4.4	4.6	4.7	4.8	4.59±.03	.65±.02
5.....	3.5	4.0	3.9	4.0	4.0	3.89±.03	.59±.02
6.....	2.3	2.4	2.4	2.6	2.6	2.49±.04	.94±.03
7.....	6.4	6.7	6.6	7.4	7.3	6.87±.06	1.39±.04
8.....	1.6	1.8	1.9	1.9	1.9	1.82±.02	.46±.01
9.....	4.3	5.4	5.2	5.4	5.5	5.16±.05	1.08±.03
10.....	5.0	5.3	5.1	5.4	5.8	5.34±.05	1.24±.04
11.....	1.8	2.1	2.1	2.5	2.1	2.12±.04	.98±.03
12.....	3.4	3.6	3.5	3.8	3.8	3.62±.03	.66±.02
13.....	2.1	2.7	3.2	3.2	3.3	2.81±.04	1.02±.03
14.....	2.4	2.4	3.3	3.2	3.3	2.96±.06	1.50±.05
15.....	2.2	3.4	4.3	4.9	5.2	4.01±.08	1.81±.05
16.....	.8	1.2	1.8	2.4	2.1	1.67±.06	1.28±.04
17.....	1.0	1.3	1.3	1.9	2.1	1.52±.06	1.42±.04
18.....	1.2	2.8	3.6	3.7	4.0	3.04±.10	2.23±.07
19.....	.8	1.8	2.4	2.7	3.5	2.25±.08	1.91±.06
20.....	1.0	1.6	2.1	1.8	2.5	1.82±.06	1.40±.04

TABLE 43.—YERKES POINT SCALE

Mean Score for Individual Tests

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9	Total Mean	Total σ
Test 1	3.0	3.0	3.0	3.0	3.0	3.00±.00	.00±.00
2	3.9	3.7	3.9	3.8	3.9	3.84±.02	.46±.01
3	2.9	3.0	2.9	3.0	3.0	2.95±.01	.33±.01
4	4.3	4.2	4.6	4.7	4.8	4.52±.03	.79±.02
5	3.8	3.7	4.0	3.9	4.0	3.89±.02	.58±.02
6	2.3	2.3	2.8	2.7	3.5	2.72±.06	1.28±.04
7	6.3	6.2	6.8	6.8	6.8	6.59±.05	1.07±.03
8	1.6	1.7	.9	1.9	1.8	1.77±.02	.54±.02
9	4.5	4.8	5.1	5.3	5.5	5.02±.03	1.17±.04
10	5.1	5.0	5.7	5.7	6.3	5.55±.06	1.45±.04
11	1.9	2.4	2.3	2.4	2.7	2.33±.04	.99±.03
12	2.9	3.2	3.5	3.7	3.8	3.42±.05	1.18±.04
13	2.0	2.3	2.7	2.9	3.4	2.66±.05	1.13±.03
14	1.8	2.0	2.6	3.1	2.9	2.55±.07	1.58±.05
15	3.0	3.1	4.4	5.2	6.5	4.44±.10	2.23±.07
16	1.1	1.3	1.7	2.4	2.5	1.71±.06	1.28±.04
17	1.0	.9	1.4	2.0	2.5	1.54±.06	1.42±.04
18	1.5	2.4	4.0	3.8	4.7	3.24±.10	2.24±.07
19	.9	1.8	2.4	3.4	4.2	2.53±.09	2.07±.06
20	1.1	1.5	1.8	2.4	3.1	1.96±.07	1.54±.05

TABLE 44.—KNOX CUBES

PINTNER METHOD

Percent Passing Combinations Used as Age Tests

BOYS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
1BCD	100	100	96	100	98
2BCD	92	92	90	90	98
1EFG	80	82	80	76	94
3BCD	57	65	58	68	74
2EFGHIJ	...	...	64	58	68

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
1BCD	100	98	100	100	100
2BCD	96	94	96	96	98
1EFG	82	74	85	90	86
3BCD	61	60	62.5	70	80
2EFGHIJ	...	...	62.5	62	82

TABLE 45.—KNOX CUBES

PINTNER METHOD

Number of Lines Passed

BOYS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Average	4.74	5.20	5.34	5.42	5.78
Average deviation	1.24	.963	1.37	1.42	1.12

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Average	4.92	5.04	5.60	5.68	6.44
Average deviation	1.00	1.17	1.23	1.24	1.30

TABLE 46.—KNOX CUBES

PINTNER METHOD

Perent of Successes per Line

BOYS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
A	94	98	96	98	96
B	84	88	76	84	94
C	73	78	80	82	80
D	90	92	88	92	96
E	57	47	44	44	52
F	37	55	50	50	50
G	39	57	56	46	60
H	..	..	10	6	0
I	..	..	16	26	28
J	..	..	18	14	22

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
A	100	98	98	100	98
B	90	90	85	92	96
C	73	82	81	74	84
D	94	80	92	100	98
E	53	52	56	62	64
F	39	42	50	40	52
G	43	54	46	60	70
H	..	..	8	6	22
I	..	..	21	18	34
J	..	..	23	16	26

DISTRIBUTION CURVES FOR TESTS WITH NUMEROUS FAILURES DUE TO THE TIME LIMIT

Successes, 50"–480" Failures, 481"

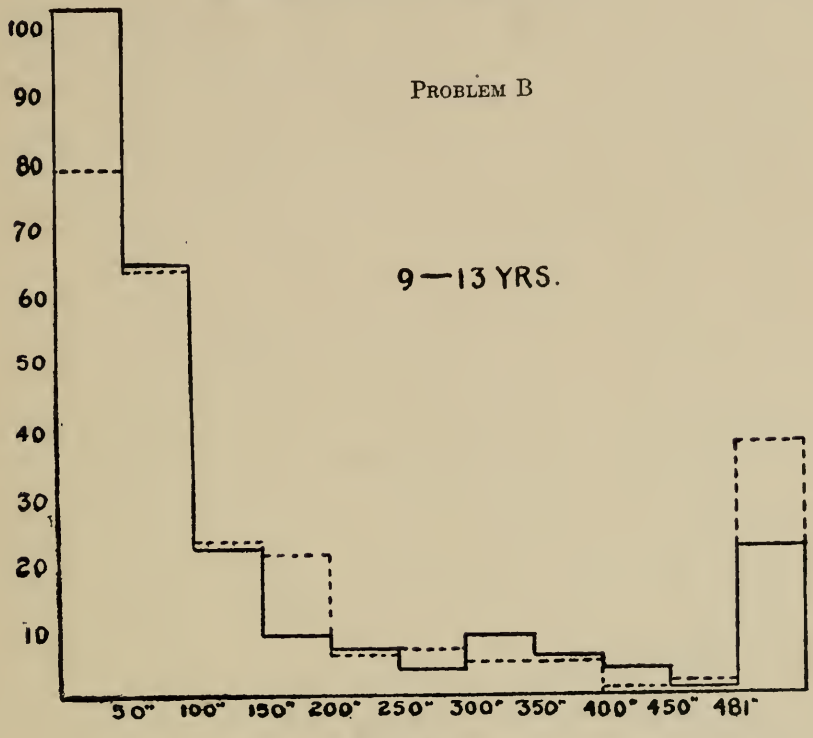


CHART A (*a*).

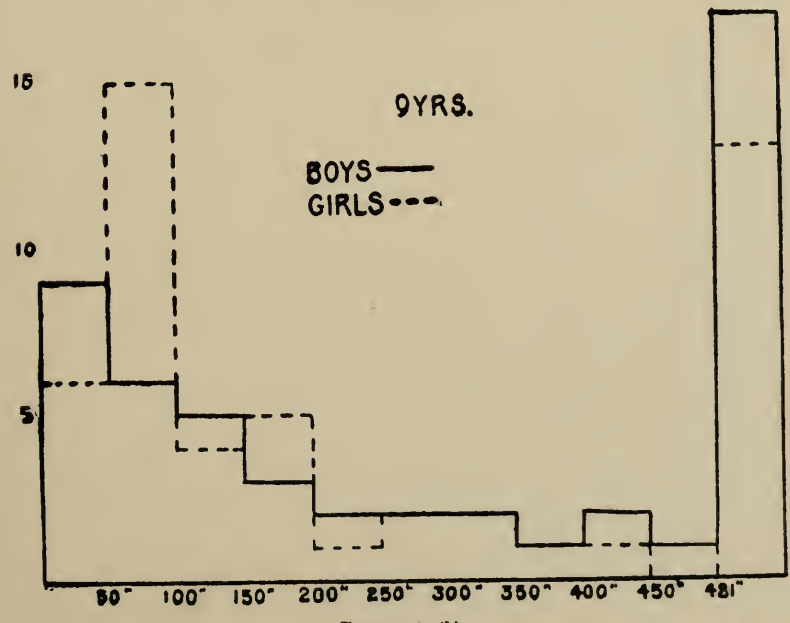


CHART A (*b*).

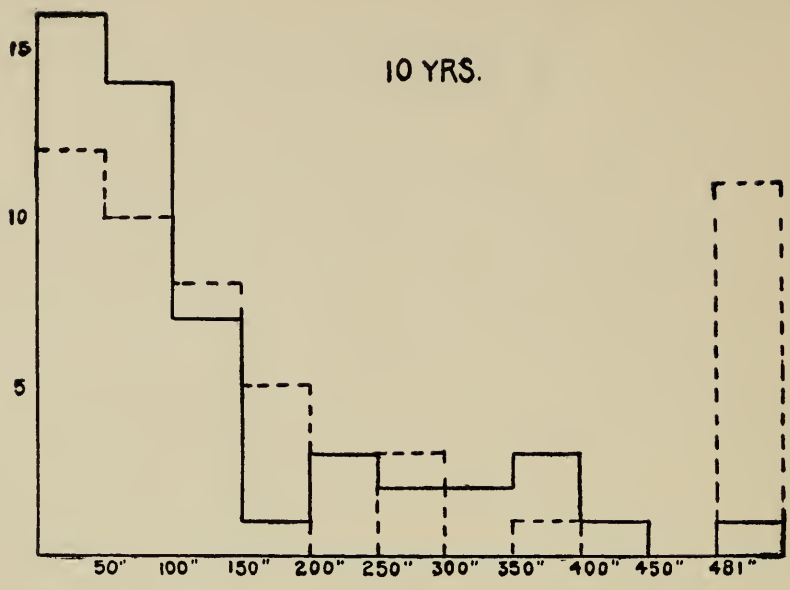


Chart A (*c*).

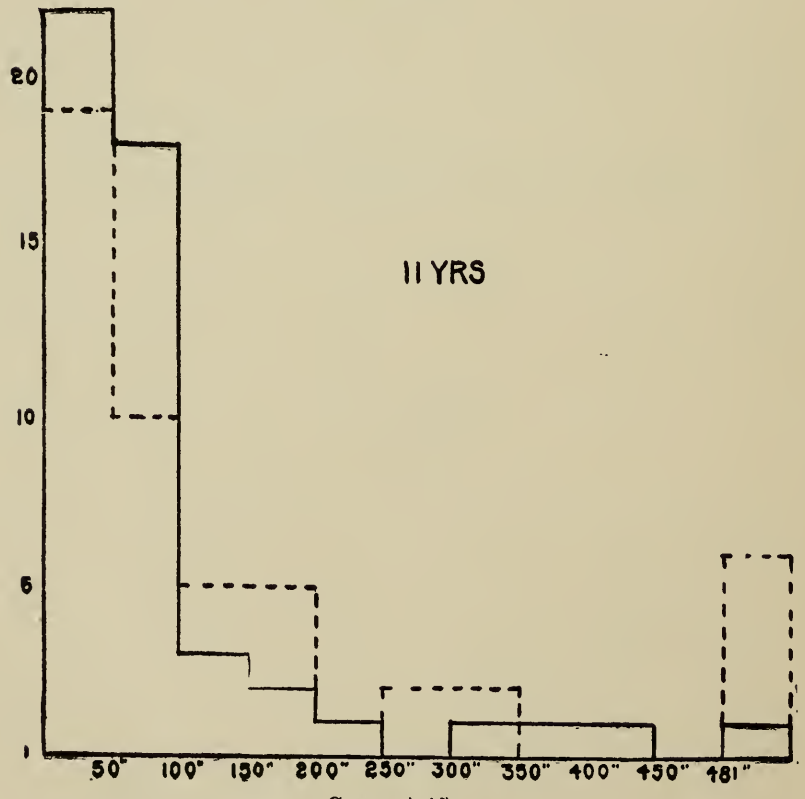


Chart A (*d*).

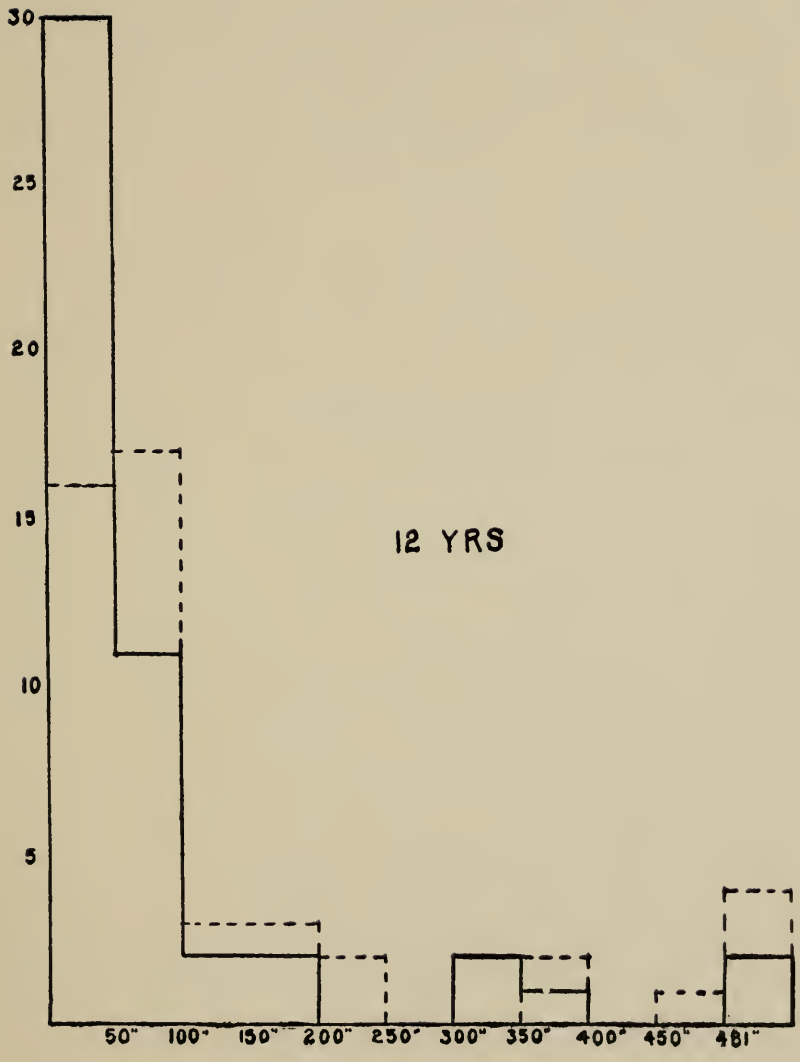


Chart A (*e*).

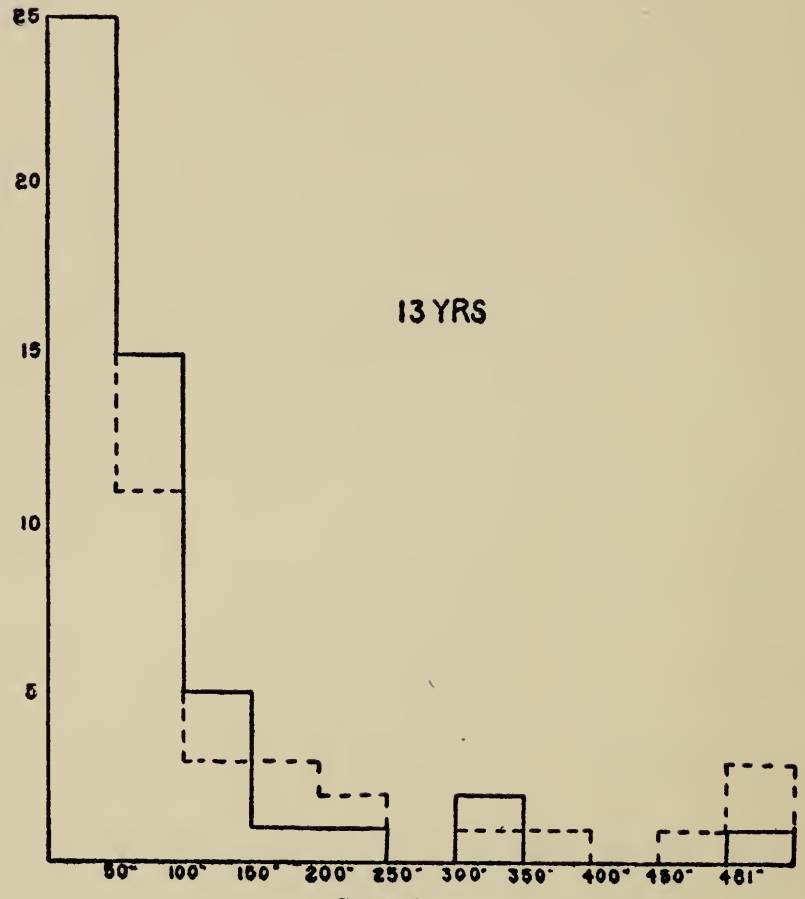


CHART A (*f*).

HEALY "A"

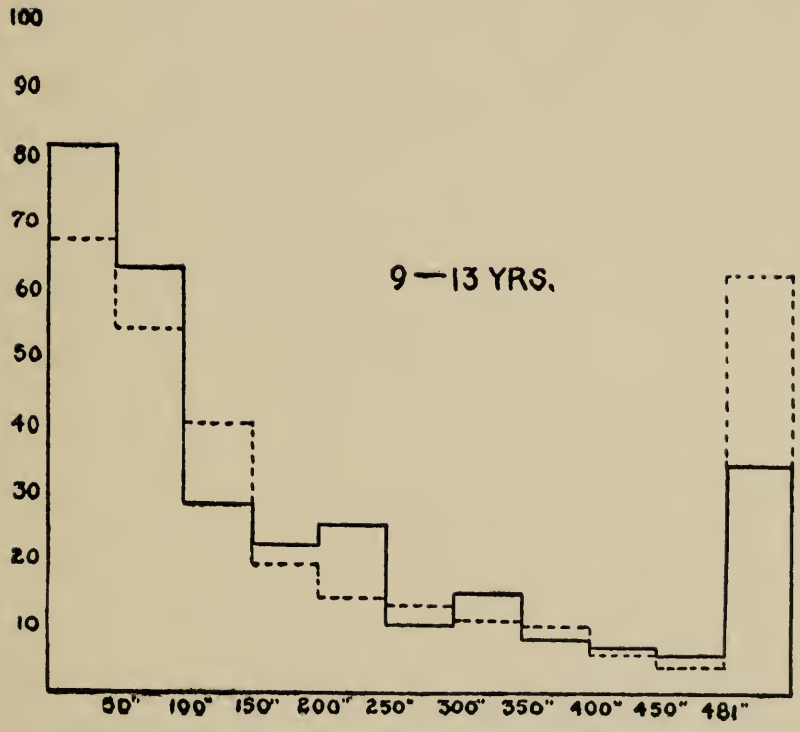
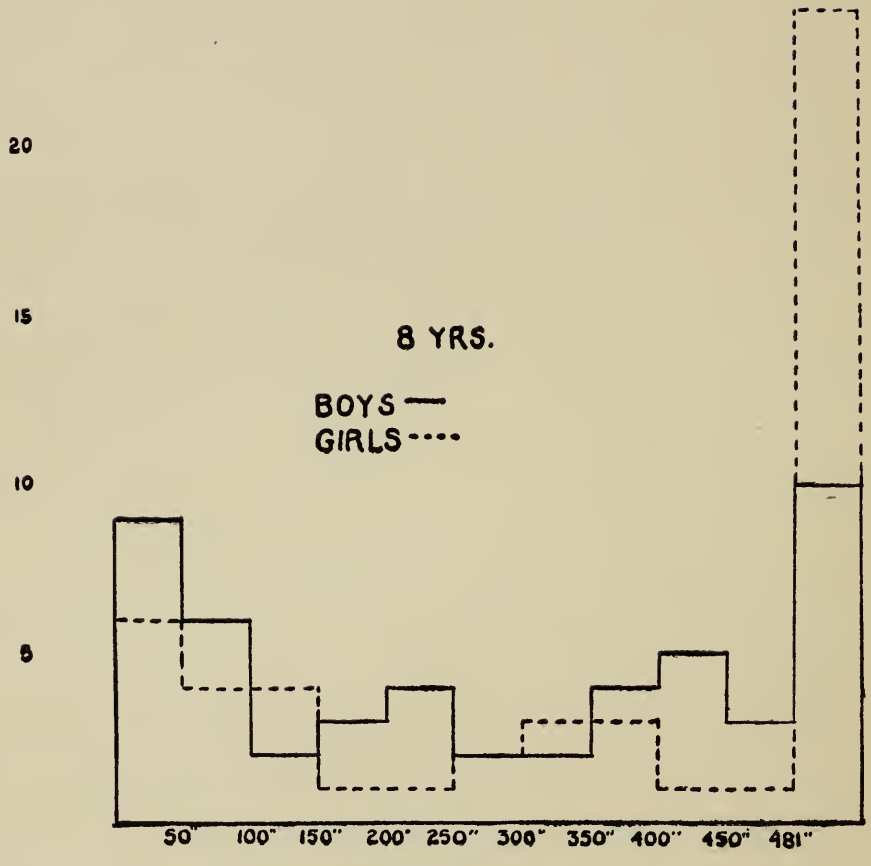


CHART B (*a*).



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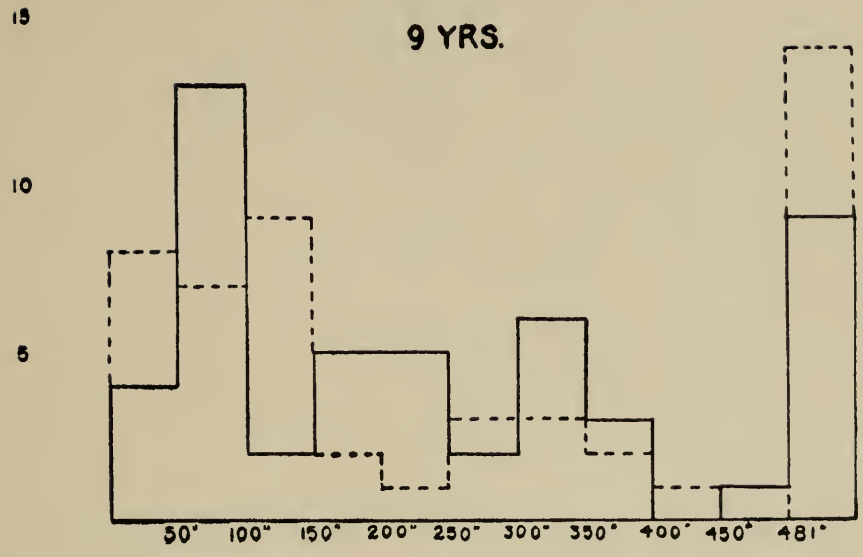

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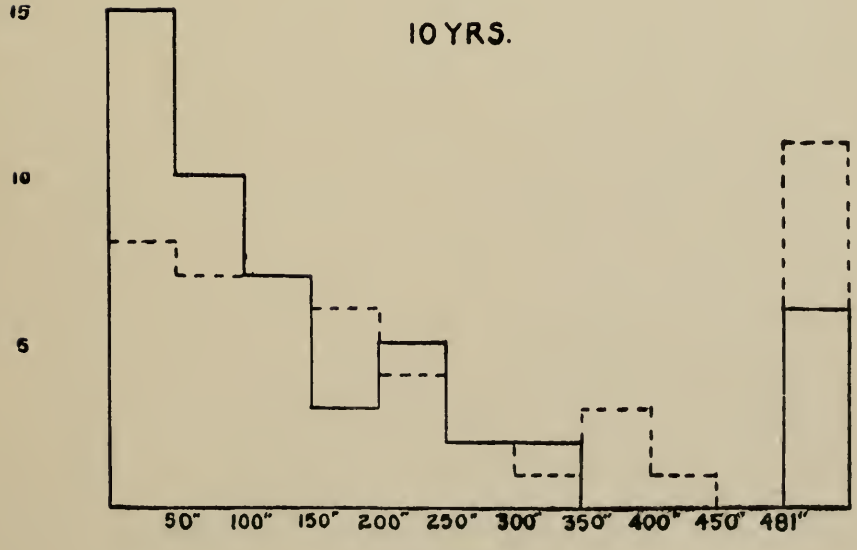
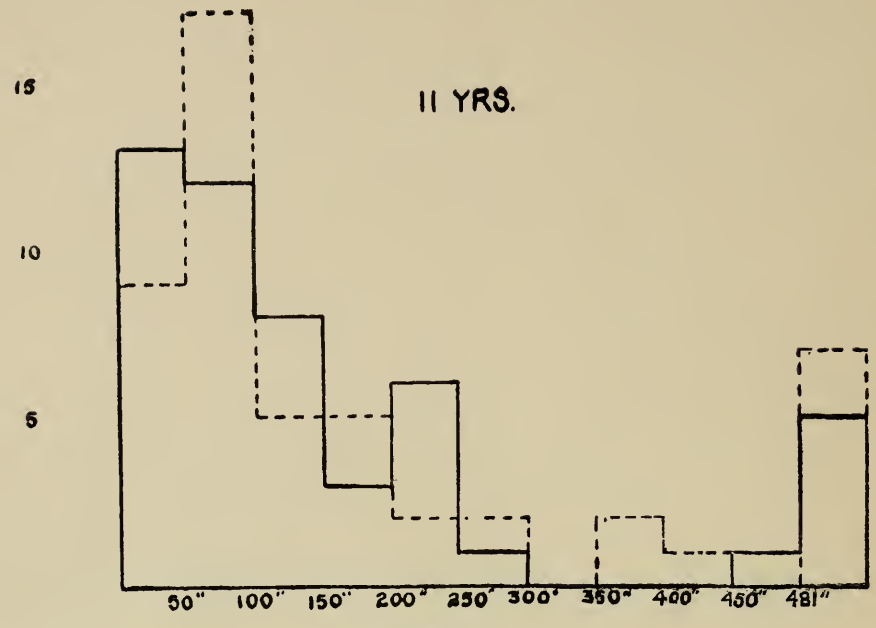


Chart B (*d*).



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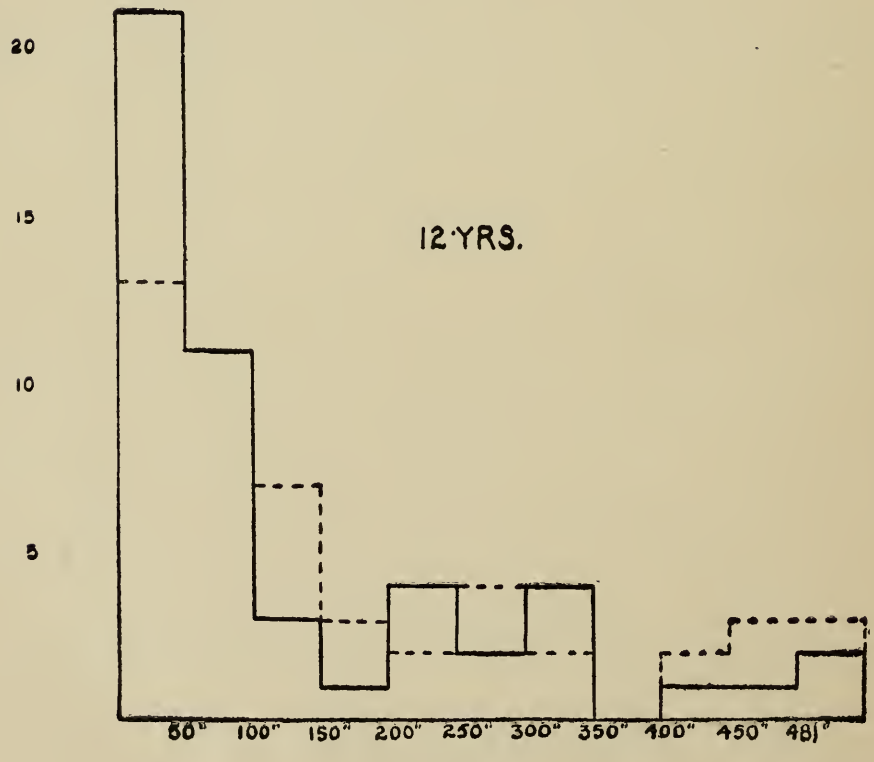

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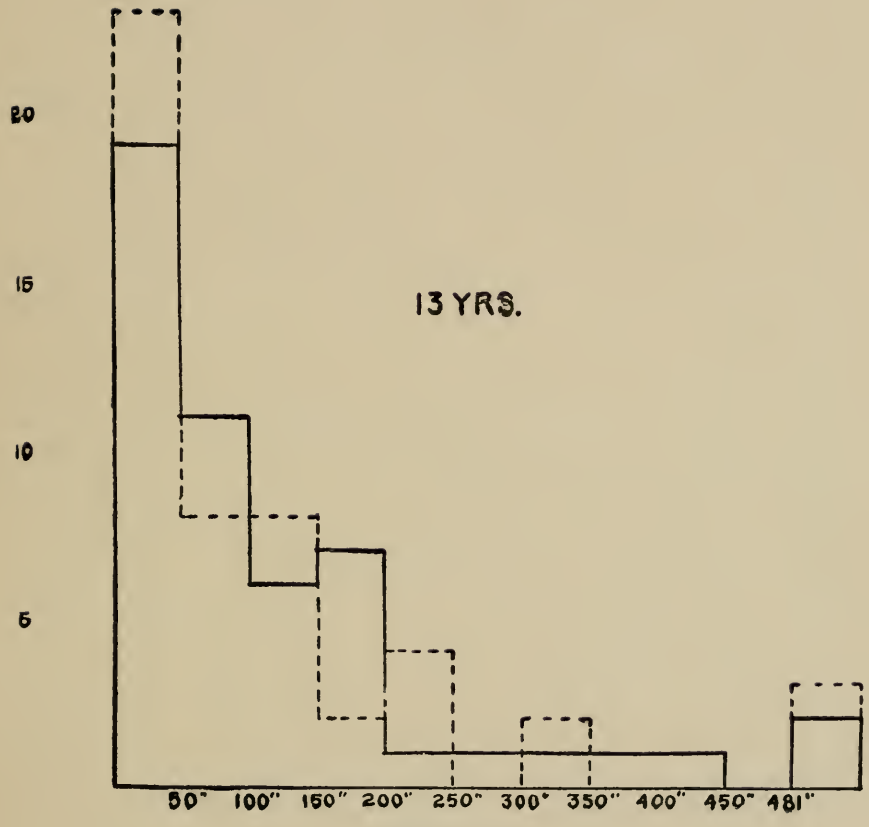

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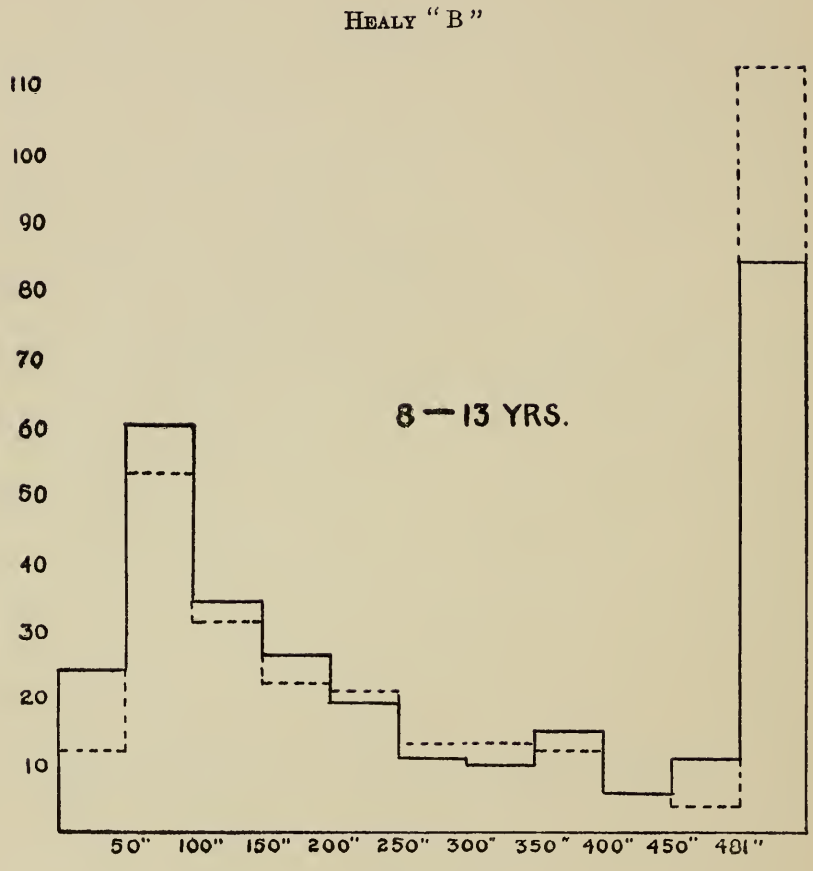

Healy "B"
110
100
90
80
70
60
50
40
30
20
10
8—13 YRS.
50" 100" 150" 200" 250" 300" 350" 400" 450" 481"

Chart C (*a*)

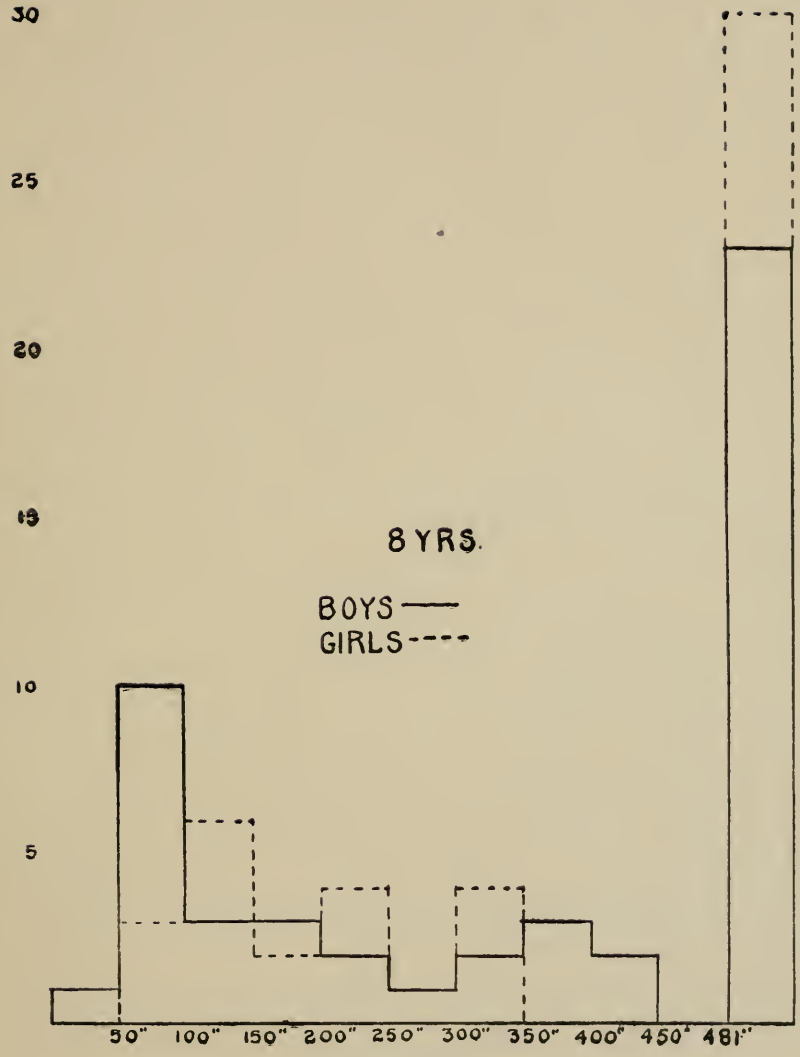

30
25
20
15
10
5
8 YRS.
BOYS
GIRLS
50"
100"
150"
200"
250"
300"
350"
400"
450"
481"

CHART C (*b*).

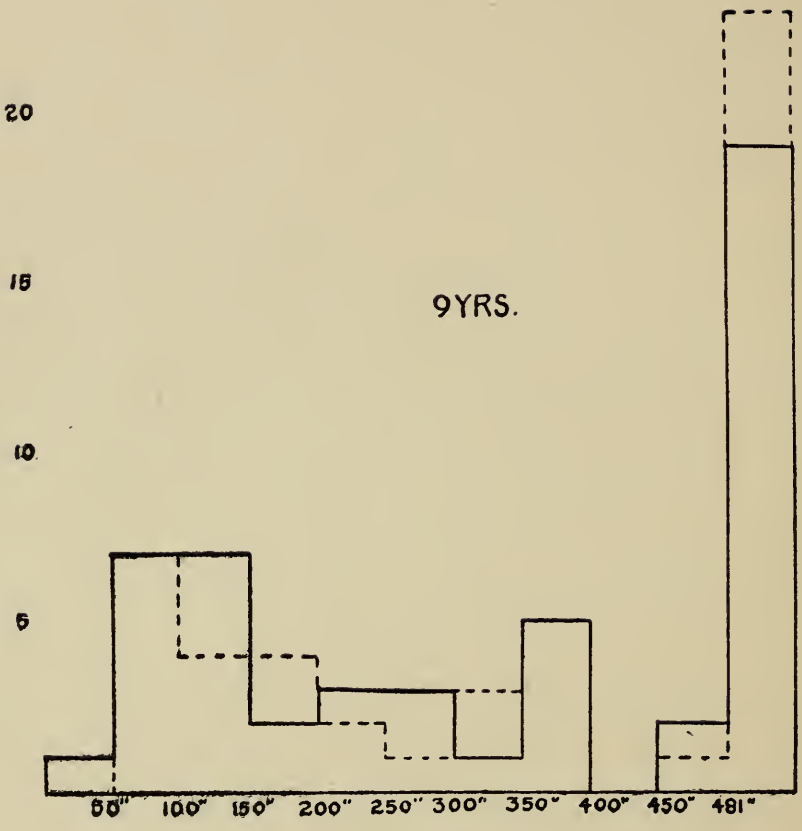
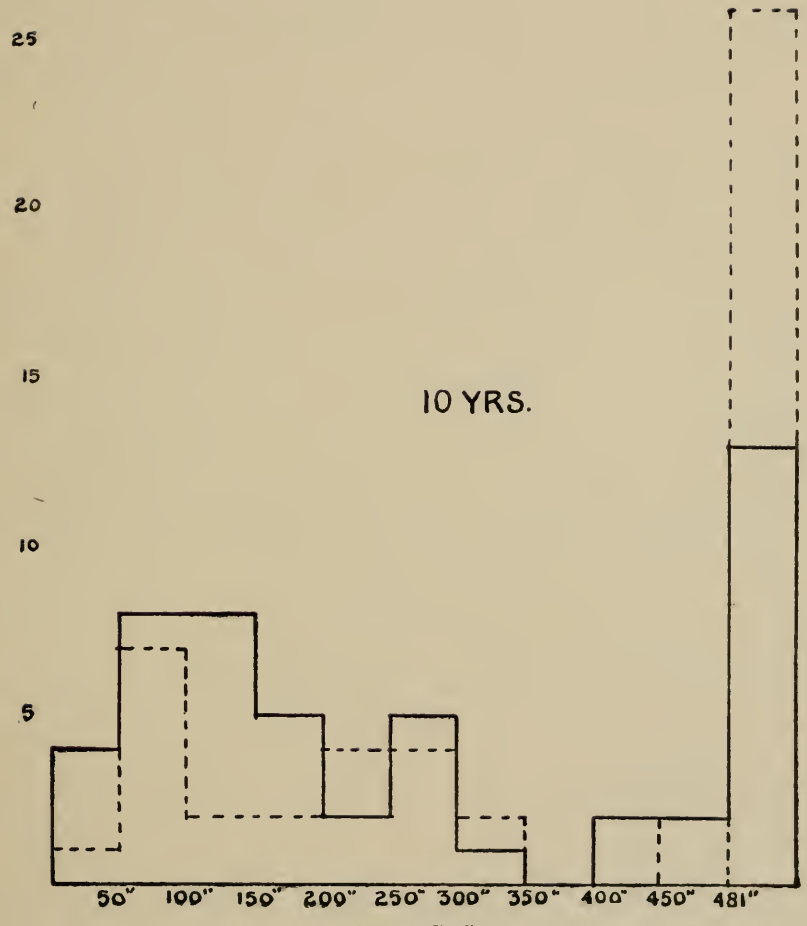


Chart C (c).



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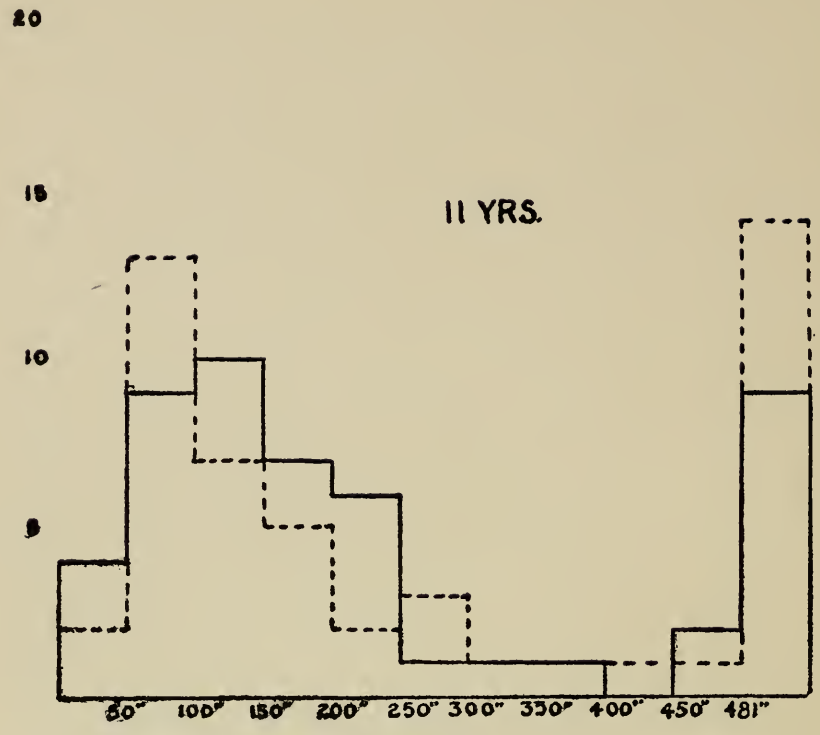

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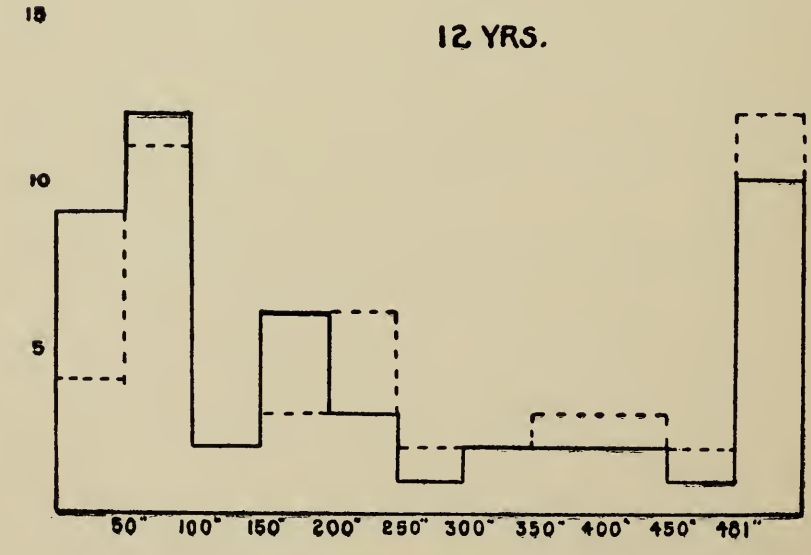
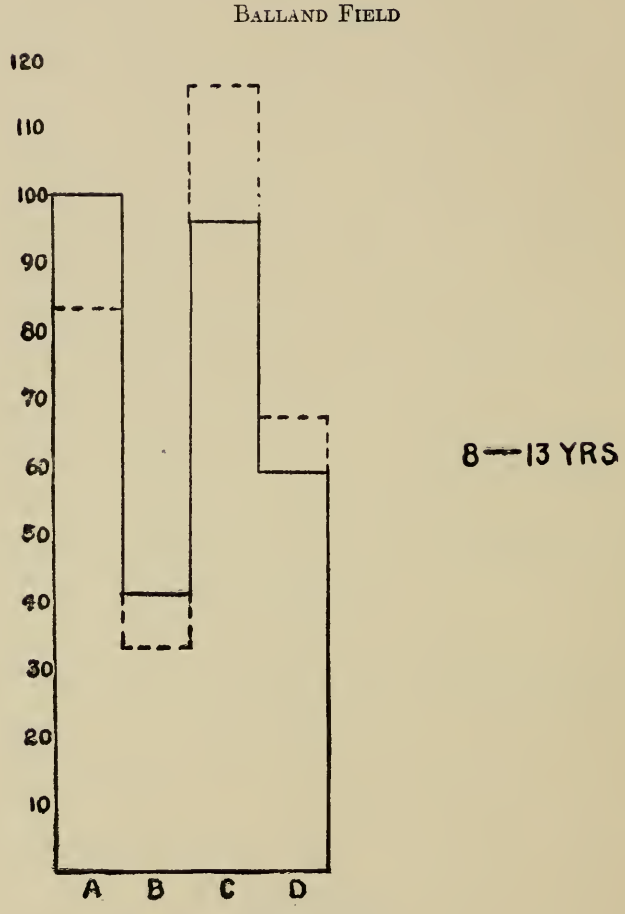


CHART C (*f*).

Chart C (*g*).



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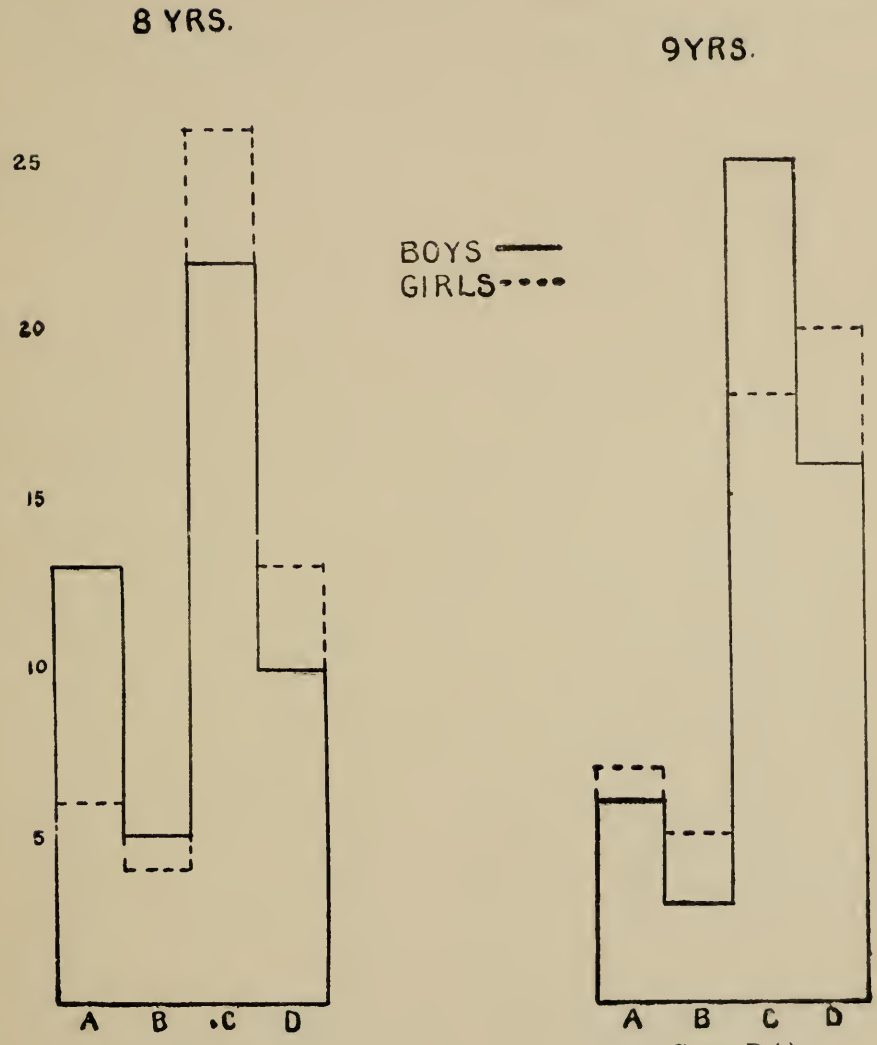


CHART D (*b*). CHART D (*c*).

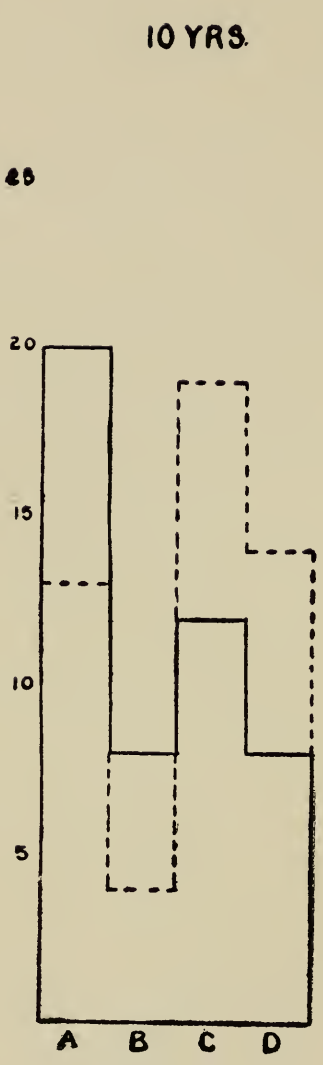
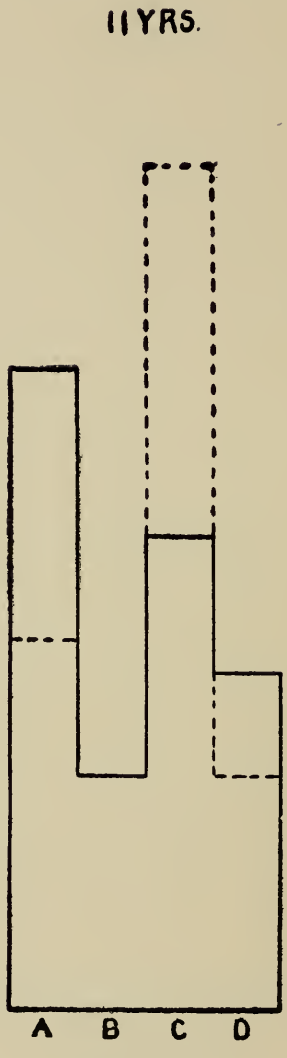


CHART D (*d*).



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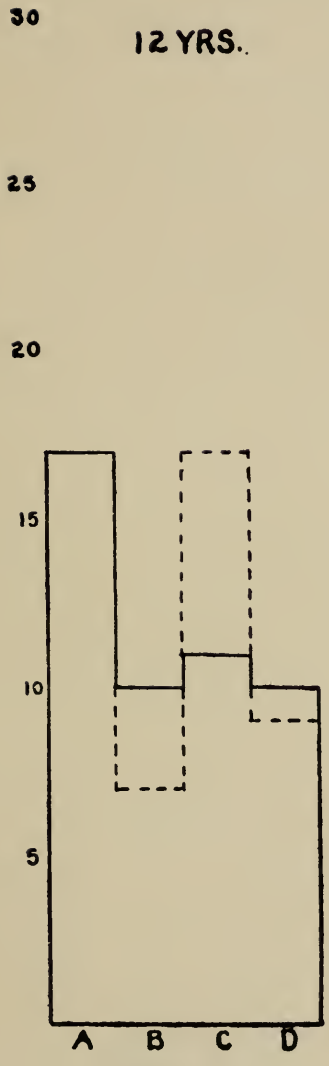

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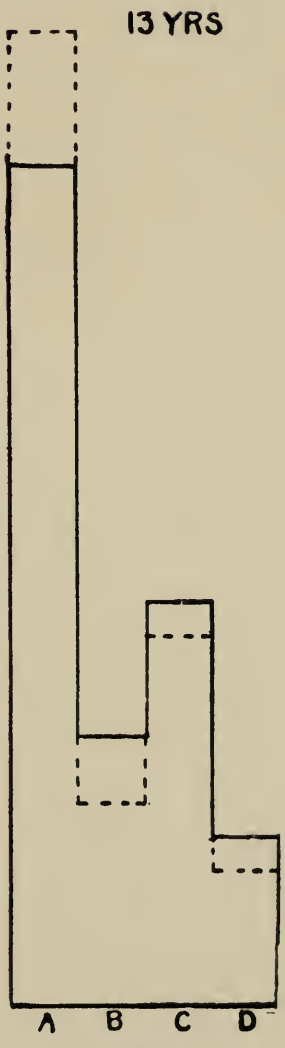


CHART D (*g*).

CHAPTER V

THE MATURITY SCALE

A SCALE has been selected from the tests used in this investigation. The resulting advantages are two: a more convenient form for use than a number of separate tests, and the elimination of those tests which are least useful for a particular purpose or which duplicate others too closely.

The most common method of combining tests is that first used by Binet. Here the age level of the different tests is determined, the results scored in terms of these age levels, and the total given as the sum of the age levels. It is not necessary to discuss the value and shortcomings of this method here since our tests do not lend themselves to this method of handling. Differentiation of subjects is obtained in our series by scoring the amount accomplished for tests given to all subjects, not by giving tests with different age levels to different subjects. This method has the advantage of giving a much finer differentiation than a plus and minus scoring, and allows for measuring the combined results by as many quantitative standards as are available.

Such graded results can be objectively combined according to two different principles. The first aims to satisfy the demand for a measure of general intelligence, and is suggested by the theory that intelligence is a general quality which can be summarized from a body of test results. Here the combination is made by selecting the tests which individually show the highest correlations with the total series

of tests. This involves two assumptions which we wished to avoid; that a test situation gets at the essential factors in general intelligence and that tests highly correlated with their own total each must necessarily function in identifying intelligence. A high relation to the total must as a rule carry with it high interrelations between the tests, so that there is a considerable duplication of measurement. Since the tests themselves are taken as the standard of intelligence and each one is related only to the total, there is no way of analyzing what aspect of intelligence is tested or what part each test plays in arriving at the total.

The second method of selecting tests having graded scores has advantages which seemed to justify its adoption for developing a scale in addition to those already in use. The tests are chosen with reference to a measurable criterion outside the test series. They are further chosen so that they do not overlap but represent as completely as possible the series of adjustments called forth by the tests. The score is stated in terms of the relation of the child's deviation from the average to the standard deviation of his age group. This makes it immediately obvious where the child in question stands with relation to other children of the same age. A further divergence from the usual procedure is the use of separate scales for boys and girls, which seemed to be called for by the sex differences appearing in the results.

The criterion chosen for the selection of the tests was chronological age. It was applied by selecting those tests having the highest correlation with age. The age of the child is a definite obtainable fact, can be measured on a linear scale and varies between sufficiently wide limits. The scale places a child with reference to other children of the same age, with regard to those test measurements which are changing with age. Whether the qualities which change with age are those which constitute intelligence is another matter. The demonstration of such a relation would of

course give the scale a wider value, but the scale does not stand or fall by such a demonstration.

It was further desired that each test should add its independent increment to the correlation with age. This was accomplished by selecting the tests having the highest correlation with age for *constant values of the other tests.* In this way equal emphasis is placed upon the developing factors in each test; if this is not done several tests which give duplicate measurements of the subject may be included in the scale. This would result in its being overbalanced in favor of a particular developing factor, and an individual overdeveloped in that direction would receive a higher score than one more normal.

The tests having the highest independent relation with age were thus selected separately from our series of tests and from the individual tests of the Yerkes scale.*

These two groups were recombined into a new series, and the partial correlations found in the same way for all the tests of this series. The multiple correlation coeffecient then showed just how much each test added to the total correlation and any practically useless tests were dropped. The remaining tests were weighted according to the relative independent contribution of each test in the group, as determined by the ratios of coefficients expressing the relation of each test with age for constant values of the other tests.

The scale is a maturity scale not because it attempts to measure maturity but because it states the position of any

* The scale was developed from the following tests: Cancellation Index Picture Completion Index, Card Sorting Time, Threading Needles, Driving Nails Narrative Pictures, Identification of Forms, Instruction Box, Cart Construction Score, Cart Construction Time, Memory for Objects, Problem Box Score, Healy "A" Score, Substitution Time, pp. 1-3, and the individual tests of the Yerkes Point Scale. Tests Nos. 1, 2, 3, 5, 7, 8, of the Point Scale were omitted because their standard deviation approached 0. Knox Cubes and Memory for Digits were omitted because the data were incomplete; Ball and Field because it was not scored numerically, and Strength and Steadiness because they do not seem to belong strictly with the mental tests.

child in its performance with reference to the normal performance of children of the same age. The scale is so constructed that the differentiation between age groups will be as complete as possible.

It must not be thought, however, that the scale which we present is the only, the best or the final maturity scale. The tests which are left in the scale are naturally limited by the tests which were originally selected for experimentation and had other and better tests been chosen in the first place, better tests would appear in the scales. The Maturity Scale is primarily a contribution in method of constructing a series of tests and only secondarily a device for practical use. However, it is believed that the scales warrant use, especially for children of a similar environment to those described here, as furnishing a foundation for psychological diagnosis.

The sex differences in the partial correlations with age were large enough to indicate that the use of the same scale for boys and girls was not the ideal procedure. The tests have therefore been selected for the two sexes, forming independent series. Many of the tests are included in both, but there is sufficient variation to make the use of the two scales a distinct advantage.

MATURITY SCALE—BOYS

	Weights
T_1 = Yerkes No. 15 (Comprehending Questions)	+.145
T = Yerkes No 19 (Hard Definitions)	+.196
T_3 = Threading Needles	+.166
T_4 = Cancellation Index	+.338
T_5 = Cart Construction Score 1 and 2	+.048
T_6 = Card Sorting Time	+.021
T_7 = Problem Box	+.062

MATURITY SCALE—GIRLS

	Weights
T_1 = Yerkes No. 15 (Comprehending Questions)	+.180
T_2 = Yerkes No. 19 (Hard Definitions)	+.122
T_3 = Threading Needles	+.116
T_4 = Cancellation Index	+.011
T_5 = Yerkes No. 11 (Resisting Suggestion)	+.147
T_6 = Yerkes No. 18 (Dissected Sentences)	+.062

Regression Equations—Boys

(1) $I = 5.642 + .145T_1 + .196T_2 + .166T_3 + .338T_4 + .048T_5 - .021T_6 + .115T_7$
(2) $I = 6.086 + .4758$ Age.
(3) $\sigma_{IA} = .689$.

Regression Equations—Girls

(1) $I = 9.382 + .18T_1 + .122T_2 + .116T_3 + .011T_4 + .147T_5 + .062T_6$
(2) $I = 7.1548 + .3848$ Age.
(3) $\sigma_{IA} = .498$.

These regression equations are used to find the total score which a given child makes in the Maturity Scale. The scores which the child actually makes in the tests of the scale are substituted in formula 1. This gives the child's maturity index. Then the child's age is substituted in formula 2. This gives the normal index for his age. The difference between the index which the child makes by formula 1, and the index which would be normal at his age by formula 2, is then found. This difference should be related to the standard deviation of the index, formula 3, to show how the variation from the normal of this particular child compares with the average variation.

CHAPTER VI

SEX DIFFERENCES

In order to emphasize the necessity of judging the sexes by different norms, the following charts are presented. To determine the significance of a difference it was related to the probable error of the difference and a difference of less than one was considered "No Difference," from one to three, a "Possible Difference," and three or more a "Probable Difference." Since the children of each sex were selected on exactly the same basis it is evident that variations between them indicate real differences and are not due to faulty methods of selection.

A general review of the charts reveals a distinct sex difference in the results of several tests but it cannot be said that either shows a marked superiority over the other in general performance. It is not the purpose of this study to inquire into the origin of this difference—whether it be inherent or due to training. Our purpose is to show why on the basis of our material it seemed necessary to judge the sexes by separate norms.

Nine tests show a probable difference. Those in favor of the boys are Strength, Cart Construction Time, Cart Construction Score 1 and 2, Nail Driving, Identification of Forms and Picture Completion; those in favor of the girls, Needle Threading and Steadiness.

Four tests show a possible difference which, though slight in some instances, appears in three or more consecutive years. The boys are superior in Picture Completion

Score. The girls are superior in Memory for Objects, Narrative Pictures, Card Sorting Time and Knox Cubes.

No difference is apparent in Yerkes Points, Binet Mental Age, Cancellation Time, Cancellation Accuracy, Instruction Box, Digits, Substitution Time, pages 1—3, Substitution Time, page 4, Substitution Accuracy, Page 4, Ball and Field, Healy "A" Time, Healy "B" Time, and Problem Box Time.

It was not possible to compute sex differences in the cases of Healy "A," Healy "B," and Problem Box because of the large number of failures resulting from our considering every performance which extended over the time limit of 480″ a failure. In the case of Terman's Ball and Field Test, the only values assigned were A, B, C, and D which do not lend themselves to mathematical interpretation.

However, the differences which do exist we believe to be large enough and frequent enough to necessitate judging each sex by its own norms unless further detailed investigations on a larger group than ours have established conclusively that no real sex difference exists.

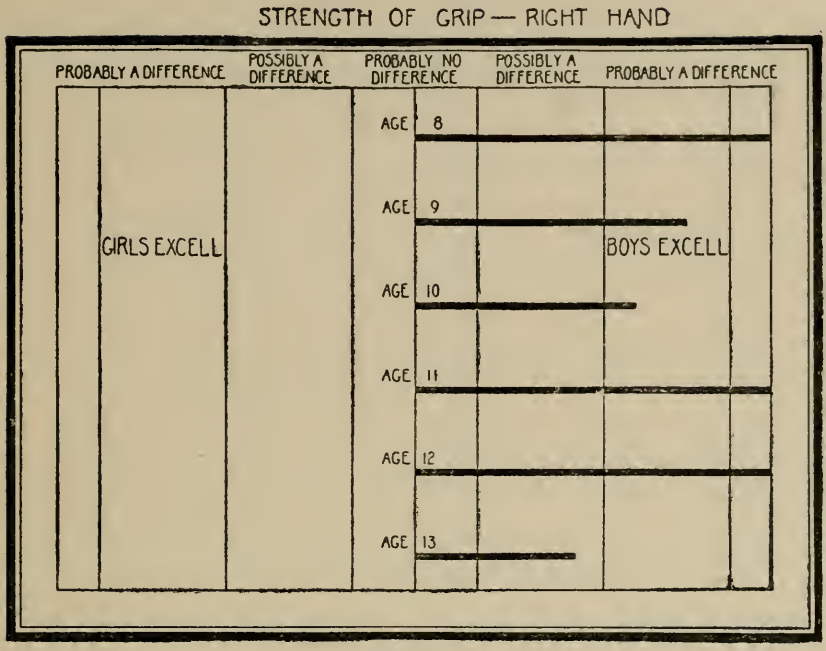
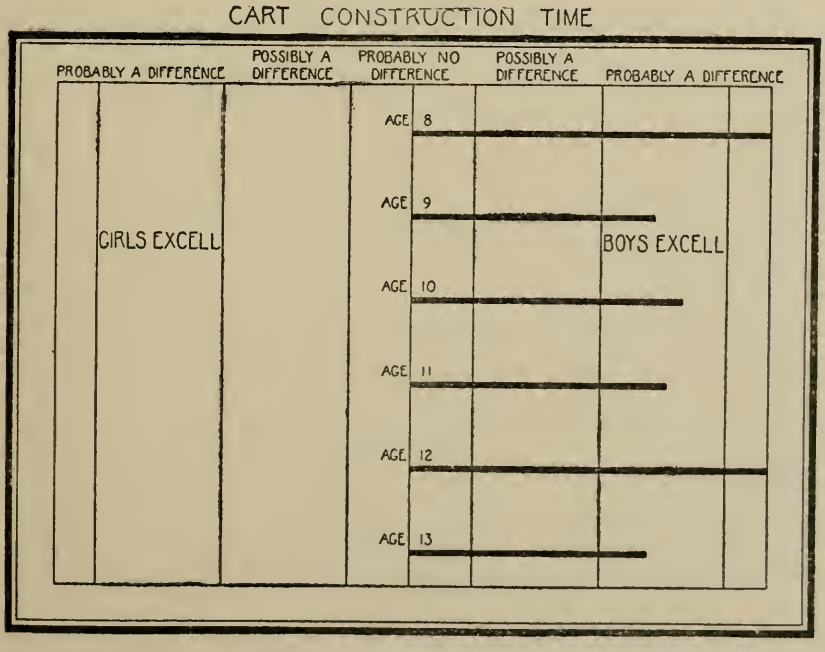


Chart 1.



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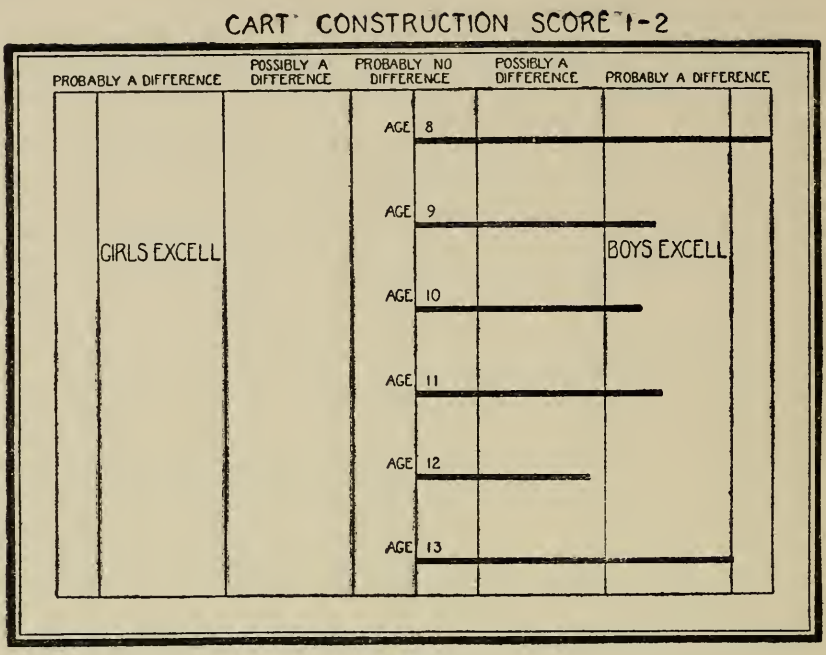

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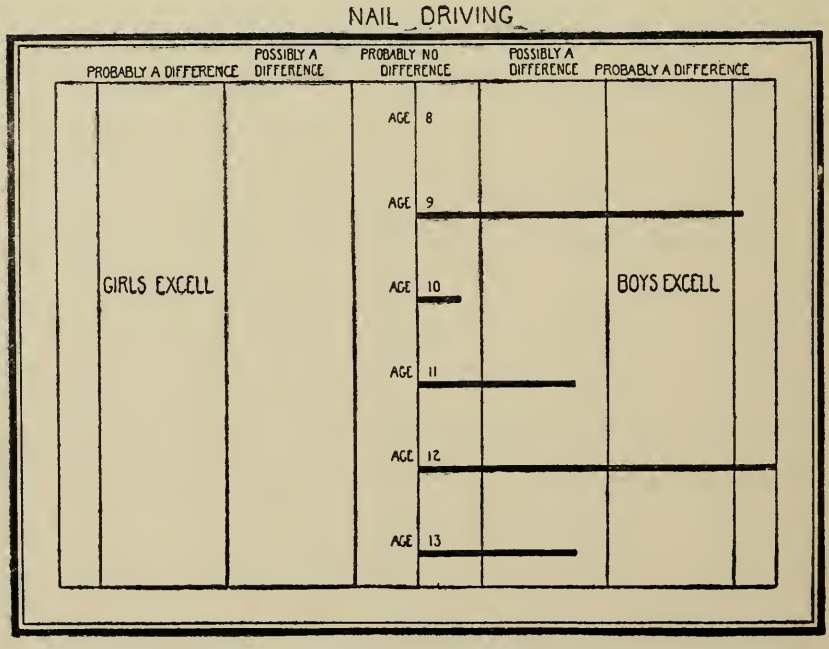

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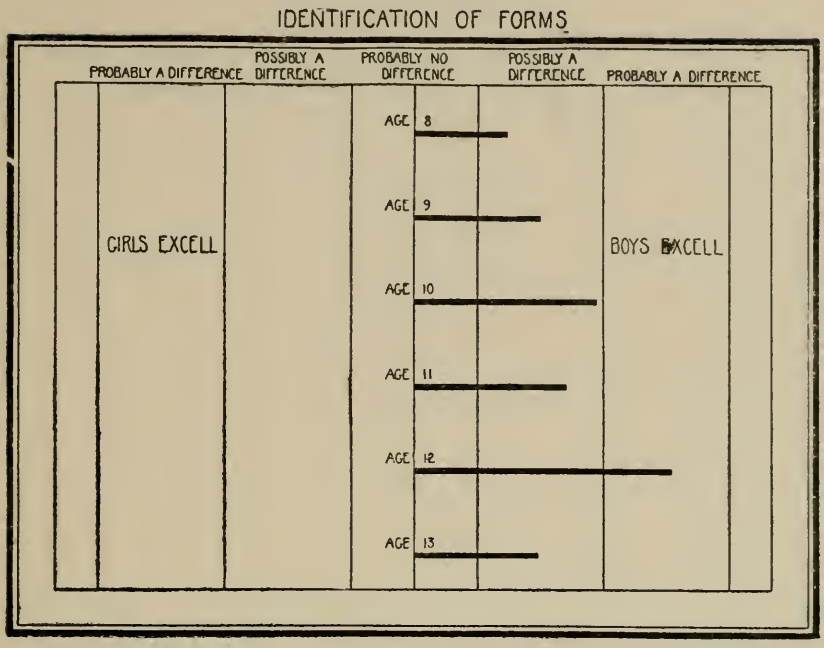

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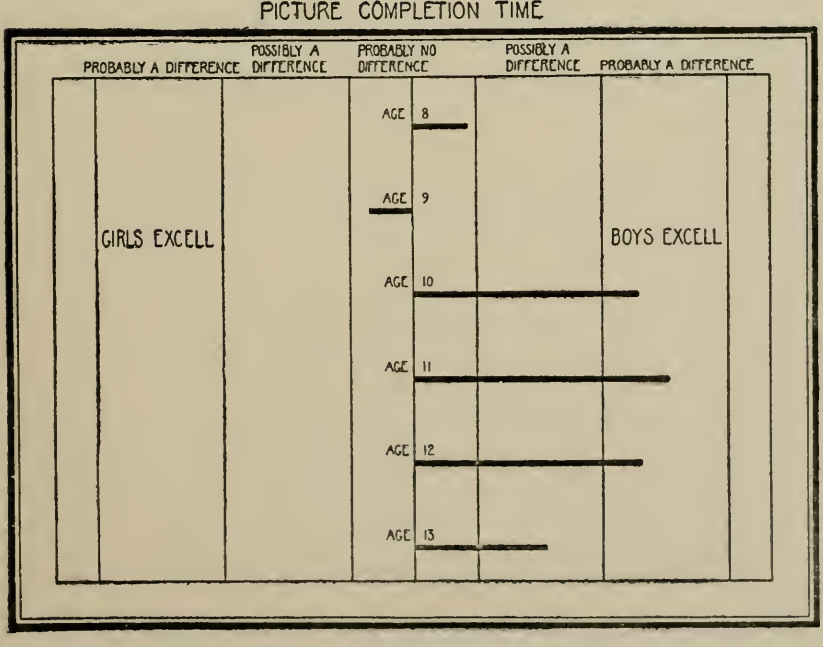

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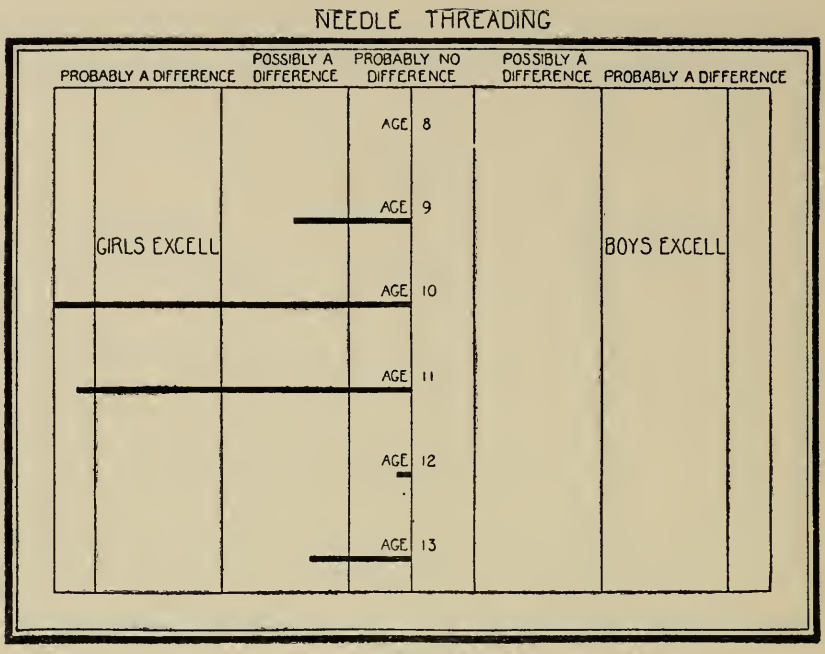

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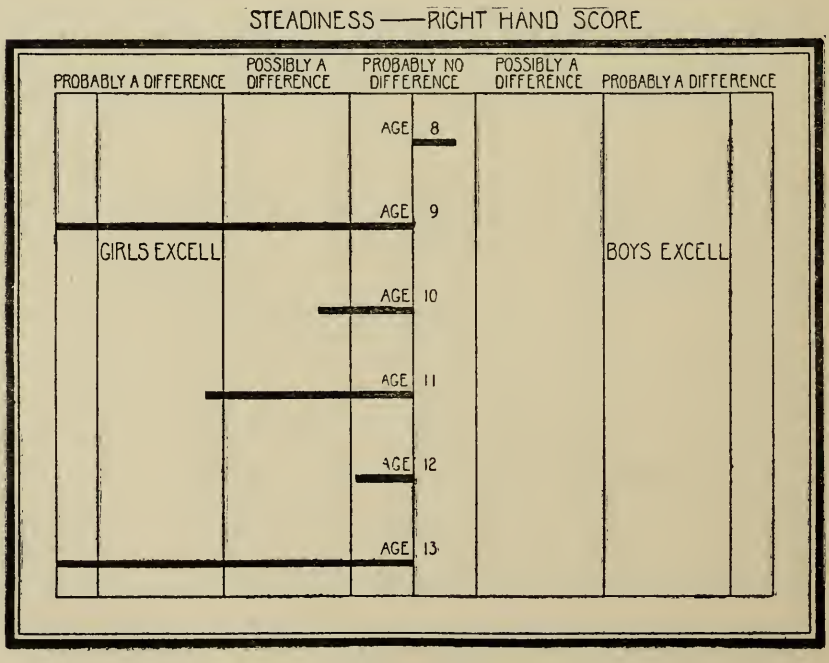

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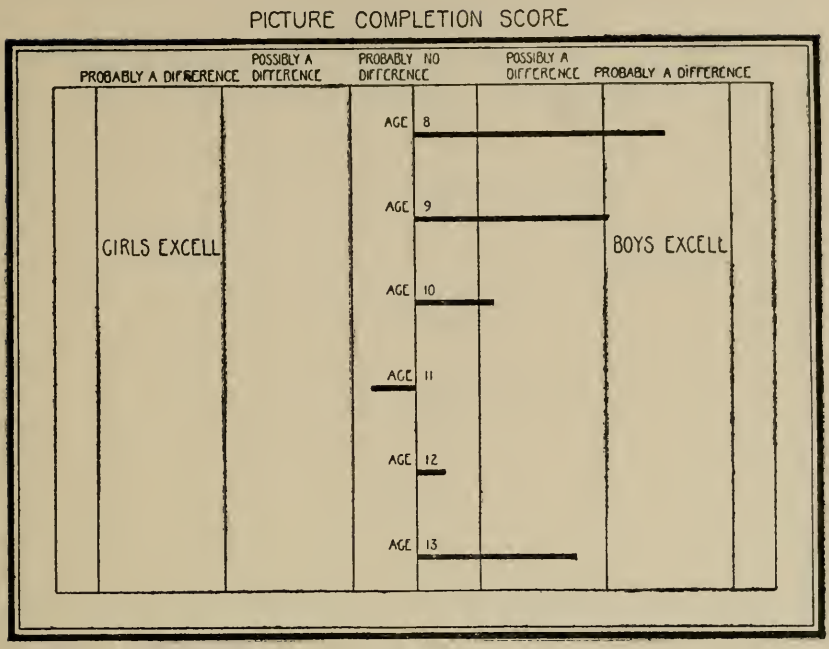

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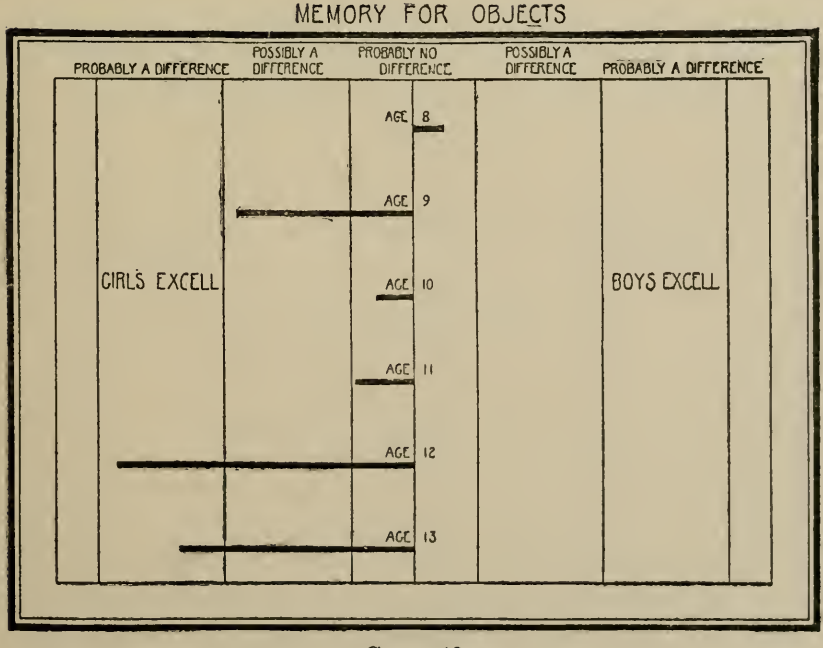

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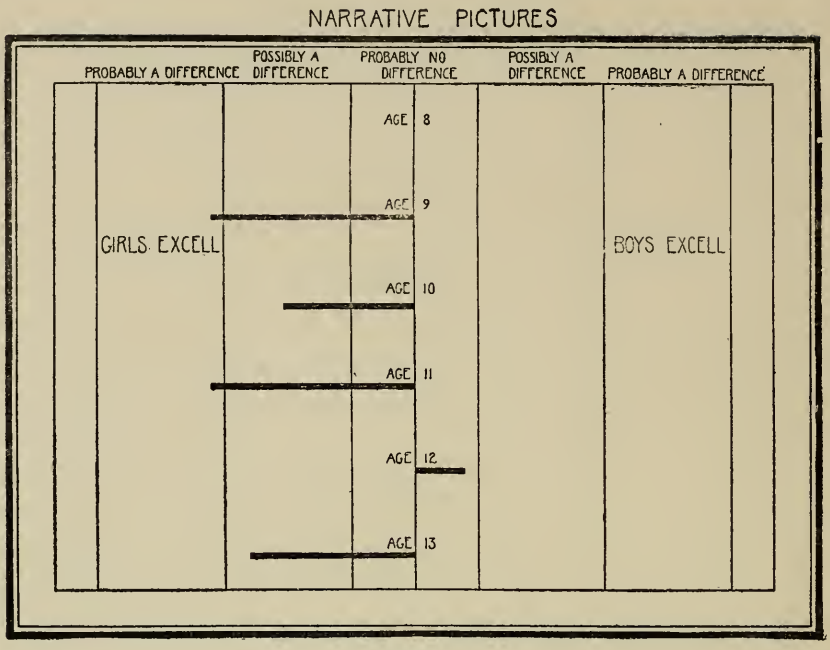

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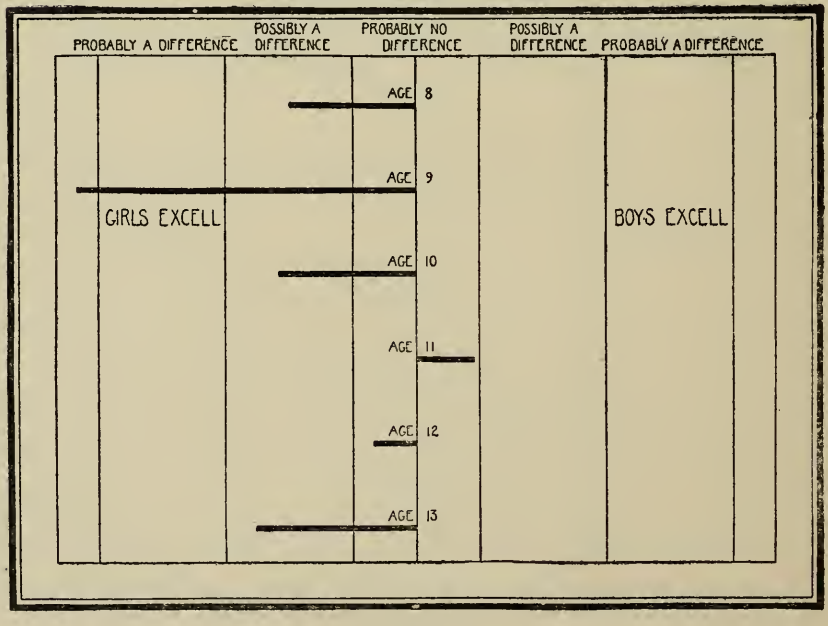

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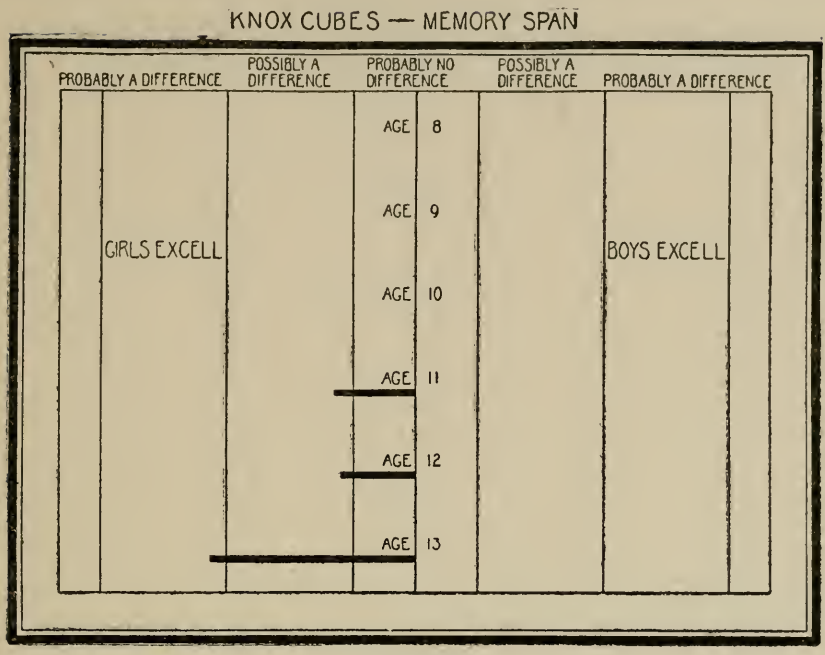

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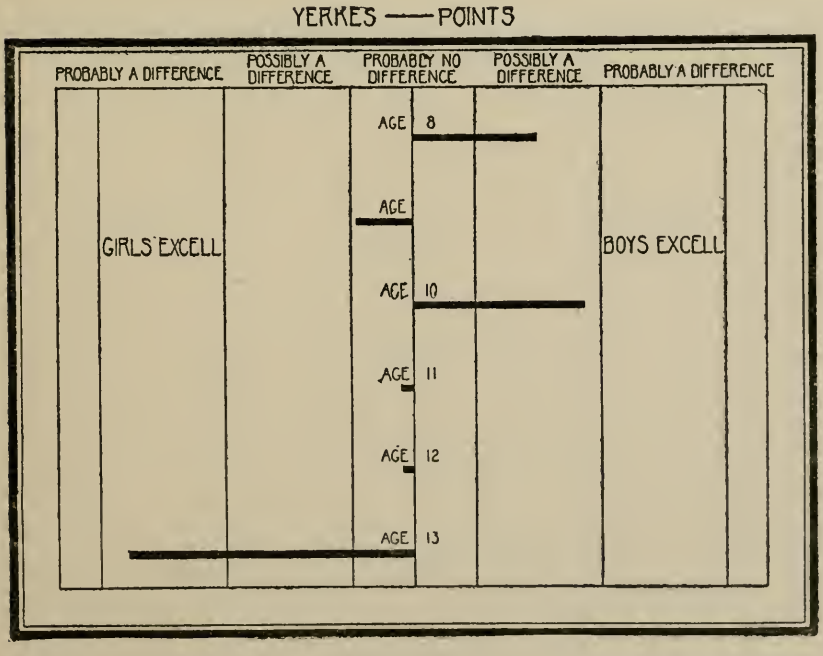

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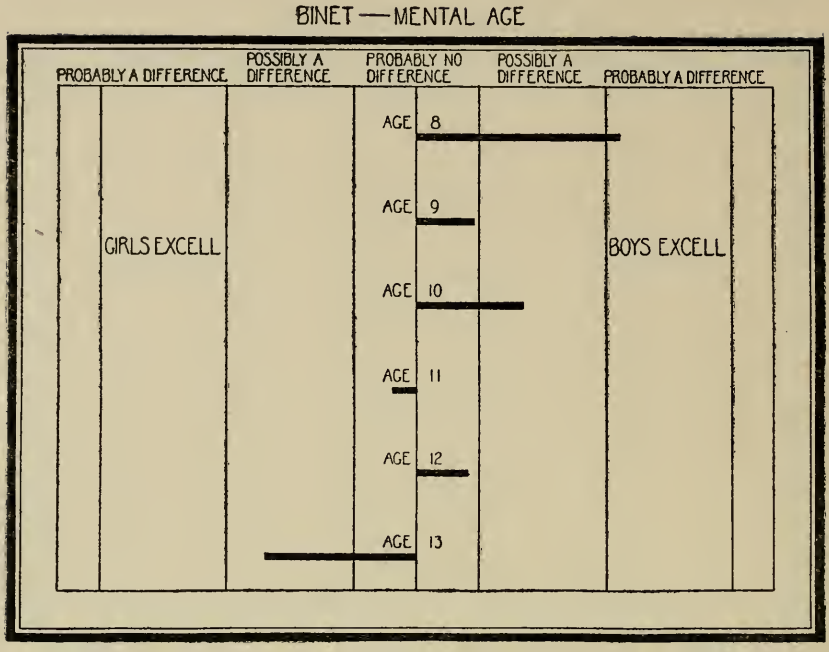

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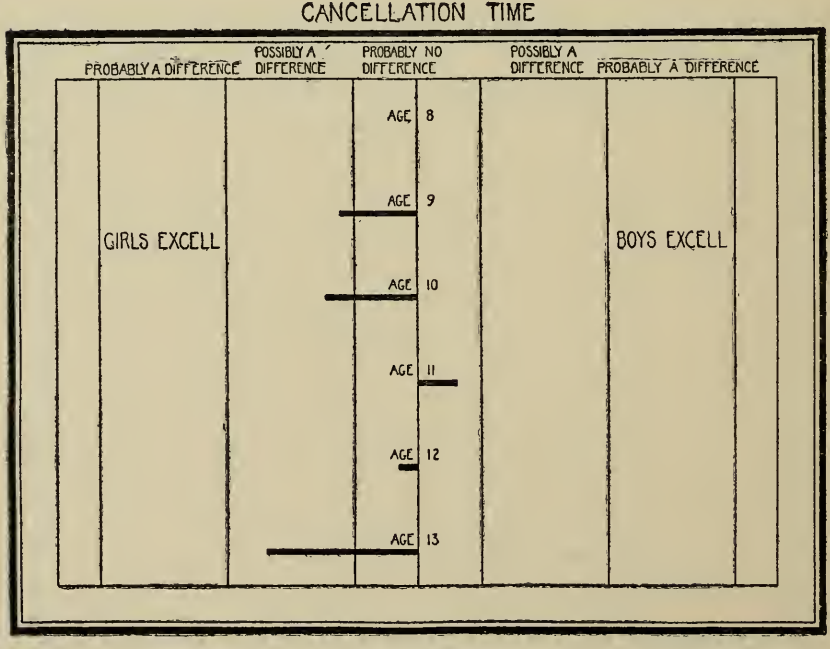

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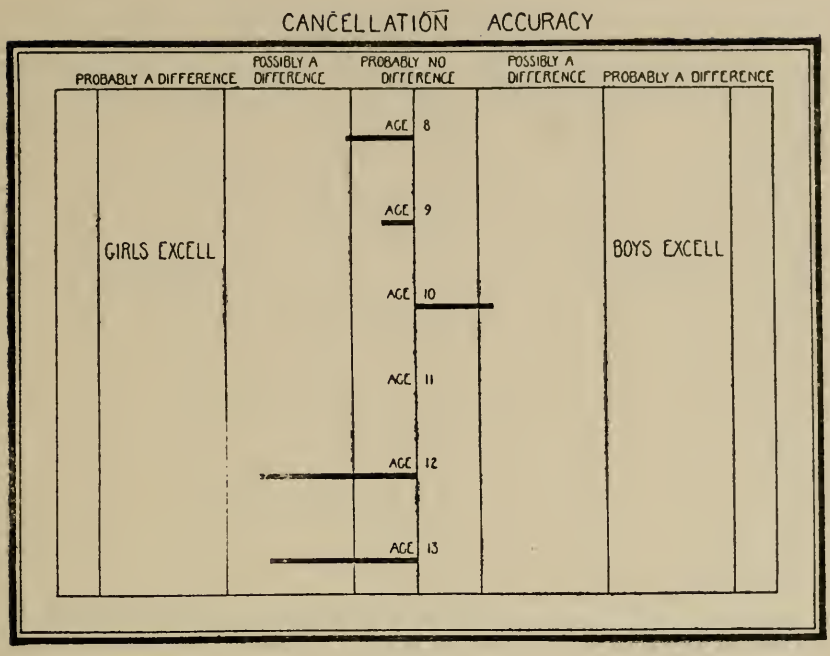

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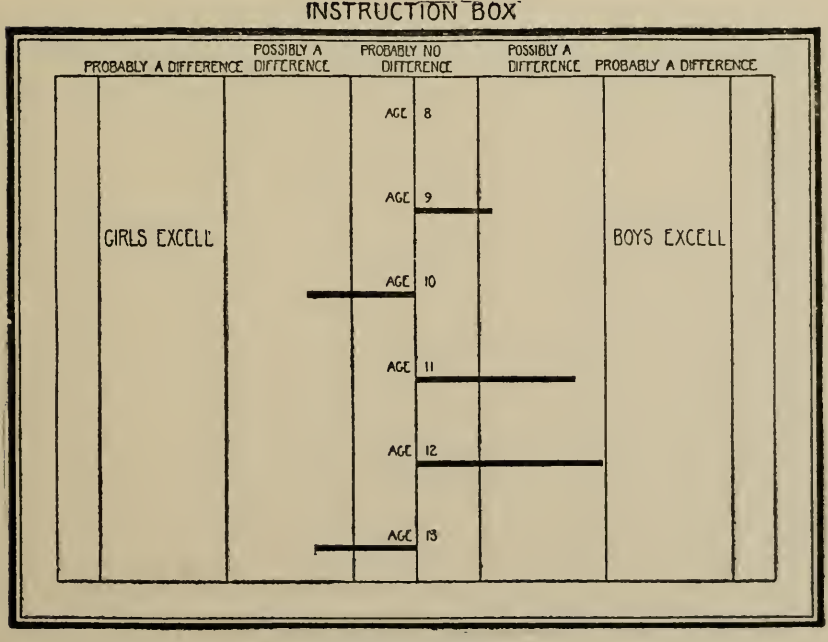

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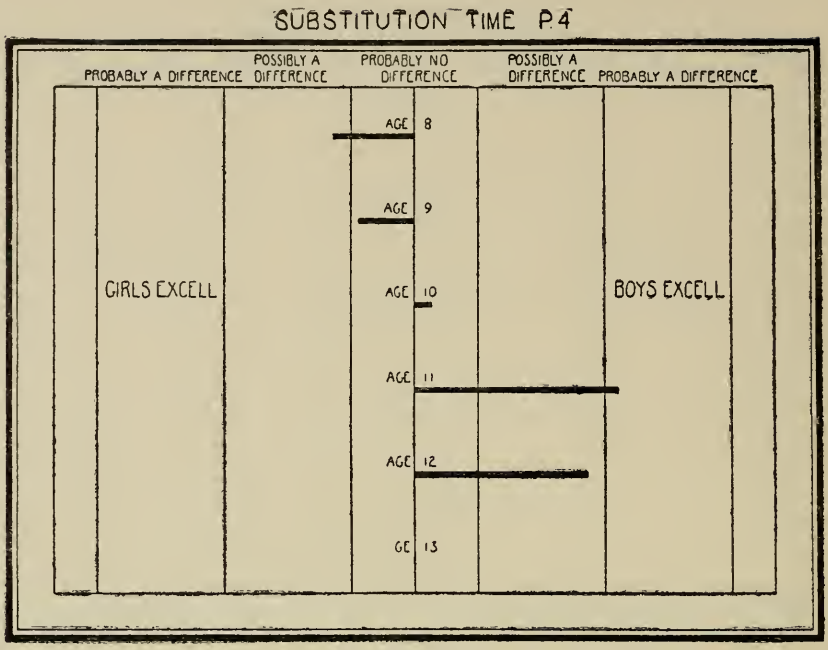

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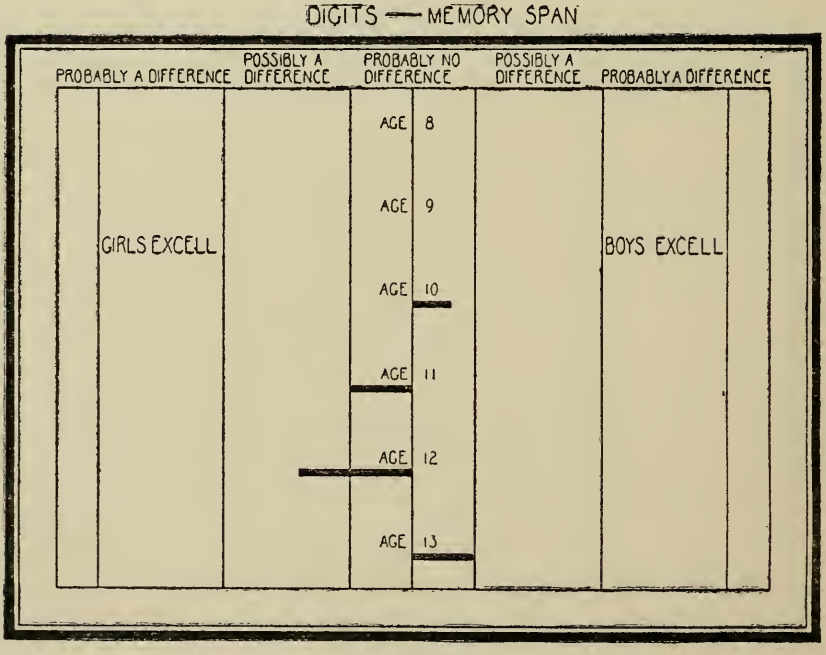

Chart 20.

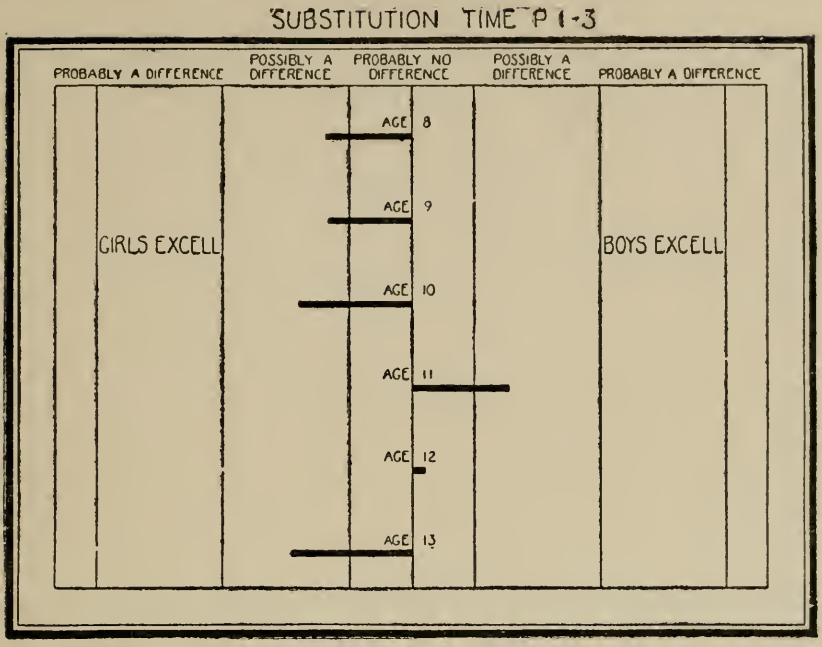

Chart 21.

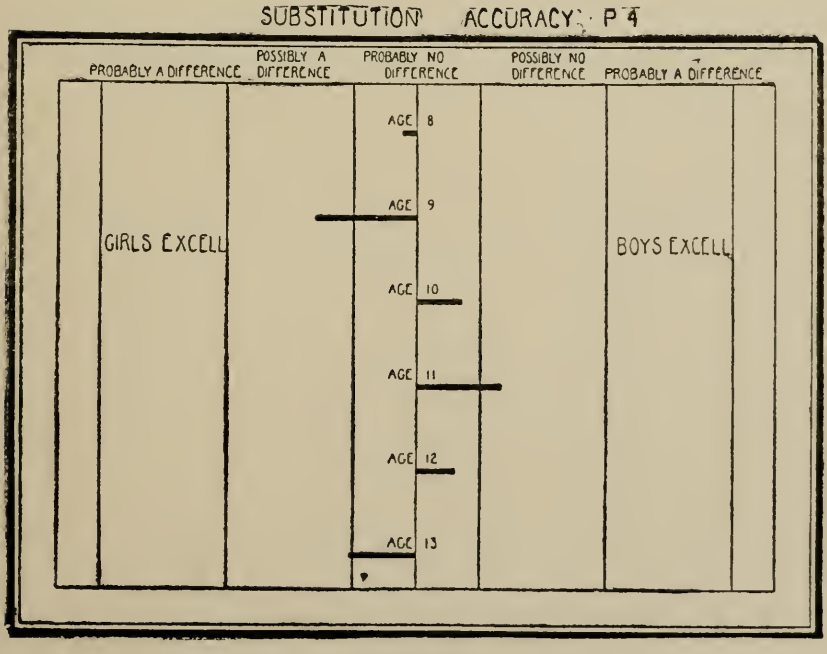

Chart 22.

PART II

SOCIAL STUDY

PART II

SOCIAL STUDY

A HOME investigation of the children in the testing groups was made in order to provide data for an extensive study of the homes from which the children came; and to furnish such facts about the indvidual child as might at the time throw light upon the results of his mental and physical examinations. The material obtained was expected to furnish information for the use of the testers and of the examining doctor at the time of their contact with the child, as well as to supply a set of facts for study after the testing was completed.

The afterstudy of the material was directed along two lines. An inquiry was made into the relationship existing between test performance and social status; and the details characterizing the home environments represented were summarized to give a quantitative description of the social and economic status of the group. This summary is offered in the form of frequency tables with accompanying explanatory notes, and it is hoped will make it possible for those who use the norms presented here to identify the comparability of other children with those who made up our testing groups.

The study of the relationship of the mental and social data was handicapped by the fact that the choice of a highly homogeneous social group necessarily resulted in a narrow range of differences in home situation. The exceptional cases which are markedly above or below the representative value for the group are too few to afford generalizations as to the

influence of superior or inferior economic status upon test performance while the main body of the social data is so slightly differentiated that it can be expected to yield little in the way of positive results for such a study of relationships.

Plan of Home Investigation

The record blank for the home investigation was adapted from the one used by the Visiting Teachers of the Public Education Association of New York City. Its form admitted of its being carried in a loose-leaf notebook during the period of the investigation and then being placed for reference in a 5x8 file with the name, address, and school description of the child in vertical position.

The *Family and Personal History* on Page 1 of the record was planned as a supplement to the doctor's examination of the child. It proved to be difficult to obtain from the mother exact and trustworthy information on these topics. The facts as to the early development of the child had never been noted or were forgotten after the birth of later children. The inquiry as to the diseases of the parents and the previous diseases of the child proved unsatisfactory since a complete lack of understanding of medical facts and terms was characteristic of the foreign groups. The mother's knowledge and memory of the past illnesses even of her own children was often confused and inadequate, and in most cases was entirely lacking for other members of the family. The facts as to the *general health and habits* of the child were easier to learn in so far as the observation of the mother extended. This information proved useful to the examining doctor as a basis for recommending to the mother better standards in the care of her child.

The items numbered 7, 8, and 10 on the second page of the blank were supplied from the child's record card kept in the school files. Since no classification of the child as

FAMILY HISTORY

1. CHILDREN	1	2	3	4	5	6	7	8	9	10
Living										
Dead										
(Cause)										
Still-born										
Miscarriages										

2. MOTHER'S HEALTH DURING PREGNANCY

(a) Bodily injury or illness

(b) Alcoholism

(c) Extraordinary mental emotion

3. DISEASES OF PARENTS OR IN FAMILY OF PARENTS

(indicate father by F., mother by M.)

(a) Rheumatism (f) Alcoholism

(b) Tuberculosis (g) Nervousness or Insanity

(c) Syphilis (h)

(d) Cancer (i)

(e) Cardiac (j)

PERSONAL HISTORY

4. INFORMATION REGARDING BIRTH AND INFANCY

(a) Born at full term (d) Labor (f) Weight at birth

" " mos.

(b) Condition at birth (e) Breast-fed (g) No. mos.

Strong Feeble

(c) Age walked Talked Teethed

5. PREVIOUS DISEASES

(a) Measles (f) Chicken-pox

(b) Mumps (g) Rheumatism

(c) Scarlet-fever (h) Meningitis

(d) Diphtheria (i) Convulsions

(e) Whooping-cough (j) Pneumonia

6 GENERAL HEALTH AND HABITS

(a) Appetite (f) Nail-biting

Stimulants Diet (g) Mouth-breathing Snoring

(b) Bowels (n) Bed-wetting

(c) Headache (i) Masturbation

(d) Nervousness

(e) Sleep

P.S. Bor. Grade Room Address Child First Name Last Name

SUMMARY OF SCHOOL RECORD, MENTAL

7. BIRTH: Date Place

8. SUMMARY OF SCHOOL RECORD

(a) Schools attended in N. Y. Elsewhere

(b) Grades repeated (c) Grades skipped

(d) Date entered IA. (e) Special classes
Past record Present record

(f) Class work

(g) Conduct

(h) Attendance

9. MENTAL CONDITION: (a) Bright Slow Dull Defective

(b) Source of information

10. PHYSICAL CONDITION: (a) Dept. of Health

ENVIRONMENTAL

13. PARENTS: (a) Place of Birth F. M. (b) Nationality F.

(e) Education: F.

(f) Use of English F.

(g) Social and religious habits:

(h) Attituda toward child:

14. INFORMATION REGARDING MEMBERS OF FAMILY

NAMES	Relationship to Child	Age	Not Living at Home	Dead	Defects	Occupations

15. NEIGHBORHOOD:

(a) Charactor

(b) Nationality

16. BUILDING: (a) Type

17. CONDITION OF FLAT: (a) No. of rooms (b) Rent (c) No. inside rooms

(f) Furnishings

AND PHYSICAL CONDITION, CHARACTERISTICS

11. GENERAL CHARACTERISTICS (Habits, Associations, Occupations)

12. STATEMENTS OF TEACHERS

INFLUENCES

M. F. M. F. M.

(c) Years in U. S. (d) Religion

M.

M.

Wages	Irregular or Seasonal	Unemployed	Home Industry	Social Agencies	Relief	REMARKS

(b) Condition

(d) Clean (e) Orderly

(g) Boarders (h) Lodgers

Visitor

P.S. Bor. Grade Room

2

Address

Child

First Name Last Name

Person in Parental Relation: Parent Relative Friend

Name

to mental condition was recorded by the school, that item was not used.

The material entered on the record under the general heading *Evironmental Influences* was planned for use in defining the social and economic status of the families of the group. In the majority of cases it was possible to obtain this information in definite and satisfactory form. The topic Wages was included in the record even though it was recognized that for the many wage earners of this group employed in seasonal work and paid on a piece-work basis, no wage earned at any one time could be considered representative of the average weekly income. For this reason no tabulation of wages is included in the summary of the material.

The item *General Characteristics* represents chiefly the statements of the mother or other members of the family about the child. Except in individual cases opportunity was lacking to seek other sources of information than the home and the school, which latter source is represented in *Statements of Teachers.* While this information could not be used in the group treatment of the material, it was both interesting and helpful in the consideration of an individual child.

The space for supplementary information on the last page afforded place for ample explanatory notes which helped to give a rounded picture of the home situation of the child.

The material was gathered by trained investigators in the course of three visits to each home. At the first visit the mother's interest in the purpose of our study was aroused, her permission for the stripped physical examination of the child was obtained and the facts as to the health history of the parents and of the child were entered directly upon the record as the mother answered the questions. At this time the child's age was also carefully checked with whatever birth records or information the family possessed, as

it was found that the date of birth recorded by the school was frequently subject to an error of six months or a year. At the second and third visits, made to announce and to report upon the physical examination of the child, the data for the social study of the family were obtained. This material was gathered without taking notes during the visit, in order to avoid arousing suspicion or selfconsciousness in members of the family which would prevent their free response and limit the amount of general information given.

Tabulation of Social Data

The community from which the children of this study came represents as homogeneous social and economic conditions as can be found in New York City. The bulk of the adult population is made up of Jewish immigrants who came to this country to obtain for their children the educational opportunities and the possibilities for material success which they themselves lacked.

The neighborhood, known as the Lower East Side, is one of the most congested portions of the city. Owing to its accessibility to the garment factories of Manhattan, the Jewish workers in that industry have crowded into it until each square block contains the living quarters of from 1000 to 4000 people. They are housed in five and six story tenements which have been built upon every available foot of space.

A school of 3000 or more children in this district draws its pupils from an area of a few square blocks. The streets and sidewalks bounded by the brick walls of the tenements are the only play spaces the children have, unless they seek the one open square which exists in the community and in which opportunities for play activities are limited by the inevitable overcrowding.

Families shift constantly from building to building but rarely move outside the limits of the neighborhood. Some

families have lived for as many as ten or fifteen years in the same apartment. The exceptional family whose growing prosperity or adaptation to American standards of living furnishes the stimulus, leaves this community for uptown parts of New York such as the Bronx, where they are not subject to the foreign usages which characterize this section. This community also receives families from the district just south of it, where the congestion is even greater and where more marked poverty exists. It occupies a position midway between the poorest and most crowded portion of the Lower East Side and the more Americanized uptown sections where the Jewish are found.

The tables which follow are offered as a detailed description of the home environment of the groups of Jewish children upon which the norms presented in this book are based.

NATIVITY OF FATHER (600)*

Austria	155	58%
Austrian Poland	118	
Hungary	73	
Russia	168	38%
Russian Poland	62	
Rumania	14	4%
Germany	6	
United States	3	
Palestine	1	

* The total group of families to which the tables in this section apply numbers 600. Since certain data were missing upon individual records the figures in parentheses indicate the actual number of cases upon which each table is based.

Although all the parents of the group were of the Jewish race, the endeavor was made to identify separately those who came from parts of Poland annexed by Austria, Russia, or Germany, since in the Polish districts race, language, educational opportunities, and economic conditions differ from those of the country to which they were united politically.

The marked foreign character of this community is revealed by the fact that in the group of 600 families only three were found in which the parents were of American birth.

The country of birth was the same for both parents except in fifty-eight of the 600 families.

YEARS IN THE UNITED STATES OF PARENTS (594)

Mean	15.1
σ	8.12
0– 6 years	88
7–12 "	146
13–18 "	190
19–24 "	78
25–30 "	69
31–36 "	20
37–42 "	3

Frequently the father came to America from one to three years in advance of his wife and children. In such cases the time in this country is reckoned from the arrival of the mother and children and the establishment of the American home. The three cases in which both parents were born in the United States were excluded in reckoning the mean.

ENGLISH SPOKEN BY THE MOTHER (575)

Fair or good	352	61%
None or poor	223	39%

Years in U. S.	Fair Good	None Poor
1– 5	4	61
6–10	25	43
11–15	88	72
16–20	96	27
21–25	60	11
26–30	44	7
31–36	35	2

Since communication in the home necessarily centers about the mother, the proportion of homes in which Yiddish

instead of English was used can be judged from this tabulation. The group headed Fair or Good includes those who were able to use only simple, conversational English as well as those who spoke with greater fluency. Those listed under the heading None or Poor, which contains more than one-third of the group, were unable to use or understand English well enough to carry on a connected conversation.

The majority of parents had received only the most rudimentary schooling in Europe. Upon coming to this country few make the attempt to learn English in the various night classes for foreigners; nor do they acquire the language from contact with English speaking neighbors. Living in the midst of a large foreign population, the mother has little opportunity and no need to learn English. She purchases all the family clothing and household supplies from pushcarts and little shops in her own neighborhood, and rarely leaves home on any other errand. The father sometimes gains a greater familiarity with English in the more varied contacts of his work, but often he too works among those of his own race and hears only the English brought from school by the children.

FOREIGN-BORN CHILDREN IN TEST SERIES

Showing Age at Coming to United States

Number..... 166
Percent of whole group..... 28%

Age at coming to U. S.....	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
0– 5 years.....	17	10	15	17
6–10 "	9	9	7	9
Percent of each age group ..	26%	19%	22%	26%

Age at coming to U. S.....	12.0–12.9	13.0–13.9	Total	Percent of 600
0– 5 years.....	17	19	95	16%
6–10 "	23	14	71	12%
Percent of each age group ..	40%	33%		

This tabulation shows that of the group of 166 foreign-born children, 71 or 12 percent of all the children tested were of school age when they arrived in this country. In the 8 and 9 year groups there were seven who had lived in this country from eight months to one and a half years when they were tested; and in the 10, 11, and 12 year group, there were twelve who had been in America two or two and a half years at the date of testing. All others listed in the table had been in the United States three years or more at the time of the study.

It was found that the foreign-born children who were in the regular school classes and were accustomed to hearing instructions in English, suffered little handicap in taking the tests, since only two, the Binet-Yerkes Scales and Opposites, involved the use of language by the child.

RENT (590)

Mean	$18.16
σ	5.229

Rent	Families
$0–10.99	15
11–20.99	422
21–30.99	141
31–40.99	10
41–50.99	2

NUMBER OF ROOMS (592)

Mean	4.0
σ	1.01

No. Rooms	Families
1	1
2	13
3	50
4	282
5	111
6	27
7	5
8	3

The major part of the population in this district is housed in brick tenements accommodating from 25 to 30 families each. These vary in type from the ill-lighted and poorly ventilated buildings, which antedate the more improved methods of tenement construction, to the well-planned modern tenement in which a five-room apartment rented, at the time of this investigation, for from $25.00 to $30.00 a month.

The representative apartment for families of this group, found in the older type of tenement building, rented for

$18.00 a month. Such apartments consist of four small, unheated rooms, at least two of which receive their light and air from a narrow dark court which serves as a storehouse for the odors and bad air which empty into it. The apartment is equipped with cold running water, and there is a toilet in the hall used in common by the four families on the same floor. The halls and stairways of the buildings are often dark and ill-smelling.

There is still to be found in this neighborhood an occasional private house remaining from the time before the influx of Jewish immigrants which resulted in the erection of the five and six story tenements. Three families in which the fathers are well-to-do professional men occupied such houses. The rent value for these was not learned. They are therefore omitted from the tabulation.

The tenement houses occupied by the majority of the children of our groups support the statement that "adequate light, air, perfect sanitation, even passable home environment cannot be provided by the best tenement which is commercially possible on Manhattan Island." *

NUMBER PERSONS IN HOME (598)

Mean	6.9
σ	1.86

Persons	Families
2	1
3	4
4	17
5	53
6	59
7	69
8	45
9	31
10	13
11	4
12	2

PERSONS PER ROOM (588)

Mean	1.8
σ	.53

Persons	Families
.4	1
.8	10
1.2	119
1.6	151
2.0	186
2.4	77
2.8	23
3.2	18
3.6	1
4.0	
4.4	
4.8	
5.2	1
5.6	1

* De Forest and Veiller, "The Tenement House Problem."

The households represented in the tabulation include, in addition to the family, such relatives or lodgers as lived permanently in the home. Almost one quarter of the whole group of homes contained such additional members as a means of supplementing the family income.

The overcrowding is indicated by the fact that the average is very nearly two persons to each room. This average presupposes the use of the kitchen as a living and sleeping room. When it is remembered that each room is usually very small, with access only to the air pocketed in the narrow court space, some idea can be formed of the conditions in which the majority of the children of this group lived.

CLEANLINESS OF HOME (576)

1 = Excellent 2 = Good 3 = Fair 4 = Dirty

Grade	Families	Percent
1	141	24
2	257	44
3	131	23
4	47	8

The rough grading of homes according to the conditions of cleanliness noted on the records was attempted in order to discover whether these tenement homes showed a normal distribution in this respect. While the tabulation seems to speak well for the standard of cleanliness maintained, it should be noted that, with no absolute basis of judgment, such a rating is chiefly valuable as a means of comparison within the group.

OCCUPATION OF CHIEF WAGE EARNER IN FAMILY (589)

Professional Service	Commercial Work	Own Business	Factory Work	Laborers		Misc.
				Skilled	Unskilled	
13	27	154	311	51	28	5
2.2%	4.6%	26.2%	52.8%	8.6%	4.7%	.8%

The factory workers who make up more than half of the whole group were mainly employed in the manufacture of clothing as machine operators, cutters, or pressers. When working full time they earned from $9.00 to $40.00 a week according to the skill they possessed. Owing, however, to periods of idleness which alternated with the rush seasons in their industry, the cost of living was an ever present source of anxiety even to many of the more highly skilled workers of this group.

The classification "Own Business" includes the small shopkeepers and venders of food, clothing, and house furnishings who ministered to the needs of the tenement population in their immediate neighborhood. The shop was usually part of the same tenement building in which the family lived or was only a few doors away from it. Often the family living rooms were back of the shop and the mother of the family shared with her husband the long hours of attendance in the shop which remained open from early morning until late at night. The members of this group earned a meager living and were with few exceptions no higher in the economic scale than the workers of the factory and laboring groups.

The remaining classifications combined contain less than a fourth of the whole group. A small proportion of these Jewish wage earners were found in the trades or in unskilled manual work outside of the factory. A still smaller proportion worked in clerical positions or as insurance agents or salesmen.

The small professional group made up of doctors, dentists, and Hebrew teachers is the only classification which in itself represents a superior economic status.

In spite of the unfavorable economic condition of many of the families of this group, only seventeen reported that they were receiving charitable aid. Since the family, from which this information was obtained, may not always have been willing to admit being dependent upon public funds

for support, the tabulation is included of families in which income from the father was lacking or in which his earnings were insufficient to support the family.

FAMILIES NOT SUPPORTED BY FATHER'S EARNINGS

	Father dead, deserted, or disabled	Father's earnings inadequate for support of family	Total	Percent
Relief received from charitable agencies	4	13	17	2.8
Family supported chiefly by mother	10	8	18	3.0
Family supported chiefly by children	9	37	46	7.7
No one working at time of investigation	..	20	20	3.3
Total	23	78	101	16.8

The economic independence of some families of the group was gained, as shown by the table, through the assumption of the financial responsibility by the mother or older children. In this community it is usual for a boy or girl of sixteen to be at work. In the homes where the father is able to support his wife and the younger children, the children who work pay into the home merely the cost of their maintenance and make such voluntary contributions to its comfort as they wish, but in the homes where the father is unable to earn the living necessities, the burden falls upon the older children. The mother, handicapped by her unfamiliarity with American ways and bound by the traditions of her religion, replaces her husband as wage earner only when the children are not yet grown.

The Jewish mother does, however, supplement the family income in various ways which do not necessitate her venturing far from home. There were 41 cases, other than those listed in the table, in which the mother acted as janitress of the building in exchange for a rent-free apartment, or

did cooking, dressmaking, or laundry work in the neighborhood. Very little factory "home work" was done by the mothers of this group, only four definite instances being noted upon the records.

In conclusion it may be said of the families to which the foregoing tables apply that there were few who endured actual physical suffering because of poverty, but that the majority felt the need of careful planning and maximum effort on the part of each grown member of the family to make their resources cover the necessities of life.

PART III

PHYSICAL STUDY

PART III

PHYSICAL STUDY

In order to obtain the complete picture of each child which we wished to have, we included as part of the investigation a thorough physical examination of all the children tested. We hoped thus to obtain a series of norms of physical status and to gather data of value for showing the relationship of physical condition to school standing and to test performance. The definite values which resulted from the physical study are presented here. The study of relationships will be discussed in another publication.

Plan of Physical Examination

The record for the physical examination was drawn up after a careful inspection had been made of the records used in other studies. In the final preparation of the blank for printing, various medical men were consulted whose knowledge and experience in connection with children made their suggestions especially valuable. The card evolved was rich in opportunity to record detail and would, we believed, afford a basis for obtaining a complete description of the physical condition and characteristics of each child examined.

The necessity of restricting the scope of the examination in certain particulars seemed unavoidable. Owing to the limited space available in the schools and noises outside the examining room, no trustworthy results could be

obtained for acuity of hearing without an undue expenditure of time in repeating the tests for each child.* The examination of vision was equally handicapped by lack of space and equipment. No examination of these senses was therefore attempted.† A superficial examination of the neuro-muscular system was all that was possible without the services of a specialist and elaborate apparatus. Digital examination of adenoids seemed inadvisable and adenoids were therefore reported by the examiner only when visible.

A record for blood pressure was included as part of the examination in order that the observations upon a normal group of children might contribute to the body of results obtained by others. The systolic blood pressure and the pulse rate for the child in horizontal and vertical position were recorded. These values were combined into the index suggested and used by Dr. Crampton as a measure of the splanchic vaso-tone and hence "an important indication of the efficiency of the body and related closely to vitality." ‡

The grading of the children according to Nutrition was undertaken at the request of the Bureau of Welfare of School Children of the New York Association for Improving the Condition of the Poor, to conform to a study of defective nutrition made by them in cooperation with the Bureau of Child Hygiene of the Department of Health, for children in public and parochial schools in New York City.

* W. T. Porter, in his report upon the measurement of St. Louis children in 1892 says: "Tests of acuteness of hearing were found impractical because of the unavoidable noise in the schools and were given up after about 7000 children had been tested."

† Although the lack of quantitative data on vision and hearing for the whole group of children is regretted, we felt that the accumulation of such material by the use of admittedly crude measures would yield results of little value. An adequate identification of handicaps in vision and hearing which would necessitate the exclusion from the series of certain test performances, was assured by the careful observation of individual children by the testers, over a somewhat extended period.

‡ Crampton, C. Ward: The Blood Ptosis Test and Its Use in Experimental Work in Hygiene, Proceedings of the Society for Experimental Biology and Medicine, 1915, Vol. XII, pp. 119–122.

The classification of nutrition which they recommended was that used by Dr. MacKenzie of Dunfermline, Scotland.*

The examination of teeth included at first only the record of the number of permanent teeth, in addition to the noting of such defects as infected gums, decayed and irregular teeth. After the physical examinations had been completed for the eight year group, however, we decided to differentiate the permanent teeth by noting the number of canines, bicuspids and molars. We hoped to obtain data comparable with those found in studies of the dentition of children which suggest a relation between eruption of teeth and advancement of physiological development.†

The physical measurements listed were those which seemed most valuable as a supplement to the physical and mental examinations and which might contribute a set of norms to the values already obtained by other investigators. At the outset our plan was to include all simple measurements of the body that could be made without great expenditure of time or the use of elaborate apparatus. It proved so difficult, however, to obtain satisfactory measurements of sitting-height, span of arms, length of leg, and girth of abdomen within the limited space and time at our disposal in making the examinations that these measurements were discontinued after the examination of the eight year children. The fact that no immediate use was being made of the data to supplement the medical examinations and that norms obtained on groups as small as ours could add little to those resulting from the many thousands of cases upon which anthropometrical studies are based, contributed to this decision.

* Manny, Frank G.: A Scale for Grading Nutrition, School and Society January 22, 1916. McKenzie, Alister, M. D.: Seventh Annual Report Medical Inspection, Dunfermline, Scotland, 1912–13, pp. 19 and 20.

† Beik, Arthur K.: Physiological Age and School Entrance, Pedagogical Seminary, Vol. XX, No. 3, September, 1913. Crampton, C. Ward: Physiological Age, A Fundamental Principle, American Physical Education Review, Vol. XIII, Nos. 3–6, 1918.

The circumference and diameters of the chest were taken as a measure of vital capacity. The head measurements were started in the hope of studying correlations between skull size and mental ability.* They were abandoned when it became evident that the chances of the material being germane to the investigation did not justify the extra effort involved in taking the measurements and making the computations. Height and weight were the only measurements made for the twelve and thirteen year groups.

The examinations were made by two physicians who were retained as members of the staff for the physical study of the children. With the exception of the eight, nine, and thirteen year groups, the plan of having the man examine the boys and the woman the girls was followed. The examining doctor had the assistance of two members of the staff in conducting the examination, making the record upon the blank and taking the height, weight and measurements of the head and chest.

The children were examined in the school building during school hours and within the period of testing, whenever possible. The usual time given to each child was from twenty to thirty minutes, but, as there was no fixed limit, individual examinations sometimes extended over a longer period. Loose robes were given the children to wear during the examinations.

A special effort was made to minimize self-consciousness on the part of the child and to prevent the examination from becoming an ordeal to him. Owing to the fact that in most cases the child had already become pleasantly acquainted with individual members of the staff and that the examining room was not strange to him, it was felt that the physical examinations were made under unusually favorable conditions and that the children were left with no impression that

* Whipple, G. M.: Manual of Mental and Physical Tests, Part I, Chap. 4, pp. 82–90.

would cause them to shrink from similar examinations in the future.

In only two cases was permission for the physical examination of the child refused by the parents when its purpose had been made clear to them. The mother was urged to attend the examination and did so in most instances. If not present she was visited and given a verbal report on the condition of the child and directions for carrying out the recommendations of the physician.

The following list of articles covers the simple equipment used in the examination:

Tykos Instrument for Blood Pressure
Table with pad upon which the child could lie at length
Fairbanks Scales
Stadiometer
Steel calipers
Steel tape
Wooden tongue depressors
Instrument for examination of ear and nose
Garments for children

Comment Upon Physical Data

From the study of the recorded physical examinations the attempt was made to identify for each child the existence of such physical defects as might prevent the free performance of mental work or interfere with the normal functioning of his physical powers. In making the study of the material for this purpose difficulties were at once met in interpreting the observations. Neither in the topics printed upon the record blank nor in the explanatory remarks dictated by the examining doctor was there any clear identification of the defects that might at the time of the examination constitute a handicap to the child. Nor was it possible to judge significant and comparable degrees of the same defect for all the children examined, since the findings of the

No. of ITEM	PHYSICAL EXAMINATION
X	1. HEAD: (a) Shape (b) Asymmetries
	2. HAIR: (a) Coarse (b) Fine (c) Brittle (d) Low on forehead (e) Pediculosis (f) Distribution
	3. SCALP: (a) Ringworm (b) Eczema
	4. FACE: (a) Forehead (b) Chin (c) Asymmetries (d) Expression
	5. GLANDS: (a) Enlarged glands (b) Scars (c) Thyroid palpable (d) Thymus
	6. CHEST: (a) Asymmetries (b) Rachitic (c) Flat
	7. LUNGS: (a) Adventitious sounds (b) Enlarged bron. lymph glands
	8. HEART: (a) Murmurs (b) Pulse rate H. V. Blood pressure H. Index
	9. BACK: (a) Scapulae winged (b) Spine: scoliosis kyphosis lordosis
	10. ABDOMEN: (a) Ptosis (b) Enlarged liver (c) Enlarged spleen (d) Hernia (e) Distention
	11. UPPER LIMBS: (a) Asymmetries (b) Shape of hands (c) Clubbed fingers (d) Nail defects
	12. LOWER LIMBS: (a) Flat-foot (b) Weak-foot (c) Bow-leg (d) Knock-knee (e) Bowing of tibiae (f) Asymmetries
	13. SKIN. (a) Pallid (b) Ruddy (c) Moles (d) Dry (e) Birthmarks (f) Scars (g) Eruptions

Checks in this column refer to corresponding numbers under "Supplementary Information."

14. NEURO-MUSCULAR SYSTEM: (a) Tone
(b) Tremors
(c) Habit-spasm (d) Chorea (e) Tics
(f) Reflexes
(g) Paralyses (h) Station
(i) Head balance (j) Hand balance
(k) Gait (l) Speech defect

ORAL AND DENTAL

15. MOUTH: (a) Gums
(b) Tongue: thick pointed furrowed large
(c) Palate: cleft v-shaped arched narrow
(d) Lips: hair-lip thick everted fissured

16. TEETH: (a) Number (b) Number decayed (c) Stained
(d) Irregular (e) Notched (f) Serrated
(g) Hutchinson's (h) Malocclusion
(i) Per. Canines Per. Bicuspids Per. Molars
(j) Eruption 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8
8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8

EYE, EAR, NOSE AND THROAT

17. EYES: (a) Size (b) Position
(c) Conjunctivae (d) Lids
(e) Strabismus (f) Nystagmus
(g) Exophthalmus (h) Vision
(i) Pupils

18. EARS: (a) Size (b) Position
(c) Meatus (d) Drum
(e) Otorrhea (f) Impacted cerumen (g) Asymmetries

19. NOSE: (a) Turbinates enlarged U M L (b) Deviated Septum
(c) Asymmetries

20. THROAT: (a) Tonsils enlarged diseased
Tonsils submerged removed
(b) Adenoids removed

21. NUTRITION: 1. 2. 3. 4. (Dumfertine)

physician were recorded in the form of unstandardized comments upon the condition they wished to note with no conclusive statement as to the degree and importance of the abnormal condition described.*

Such difficulties in interpretation occurred chiefly in summarizing the material recorded for glands, chest, lungs, back, abdomen, and neuro-muscular system.

Further study of the record blank revealed the fact that there were many topics upon it of which no use could be made in summarizing the material. Among them were those calling for descriptive characterizations of the shape of the head, face, hands, and the size and position of ears or eyes. This material was inconclusive and meaningless for the purpose of our study and could have been included in the Supplementary Information for the exceptional cases in which such observations occurred. The peculiarities of physical structure are of interest in the study of an individual child but afford an indaequate basis for quantitative conclusions as to the defective equipment of children in a group study. "Because morbid biological conditions do in some cases determine the anomalous character of a human structure, there is no justification for assuming that every appearance of the character in any individual always betokens a similar morbid origin and is itself anomalous. That defective development may determine the execessive height of some palates is no justification for supposing that all high palates are developmental defects." †

* Similar difficulties in making use of the data resulting from medical examinations are pointed out by Dr. David Heron in "The Influence of Defective Physique and Unfavorable Home Environment on the Intelligence of Children," Galton Laboratory Memoirs VIII (1910). He describes the object of the memoir as twofold:

"(*a*) To illustrate the difficulties that arise in attempting to make reliable and comparable observations on school children.

"(*b*) To indicate the difficulties met with in the statistical treatment of such observations if they are not made with due regard to the needs of the statistician."

† Goring, Charles: The English Convict. p. 23.

There were still other topics upon the card of which no use could be made in summing up the material because they were merely suggestive of some physical ill of which the diagnosis was lost unless it appeared in another part of the record. Material which is thus inadequate and, by itself meaningless for analysis by the layman is found under the general headings Hair, Skin, Mouth, and in such subtopics as Hutchinson's Teeth.

The unrelated and unsummarized noting of such items veils their diagnostic significance and seems to furnish a valueless record for preservation in studies where the child is not a subject of continued observation by the physician. It is even possible that the consideration of such topics in the progressive, routine examination of the body rather than in connection with the conditions of which they are symptomatic, may divert the examiner's attention from the discovery of the significant factors of physical condition. The detailed, descriptive form of record is of greater value in a clinical examination where the physician finds numerous details useful in his diagnosis and study of a definitely pathological condition and where such recorded details are mainly supplementary to his own constant observation of the patient. It proved unsuited to an investigation of a group of normal children such as ours where the results must be subjected to afterstudy by others than the examining physicians and must serve other uses than the medical treatment of an individual.

For the purpose either of medical inspection or of investigations for quantitative use, the physical examination must be relied upon for diagnosis of definite insufficiencies or defects. Where the physician is reluctant to make a definite diagnosis, the linking up of the symptomatic conditions with the general defect to which they trace may, at least, be asked of him. The suggestion grows out of our experience that the general material included upon such records should be definitely subordinated to the discovery

of the significant facts of physical condition and that the results obtained should not be obscured by the recording of uninterpreted facts or by the amassing of descriptive material of doubtful use.

The great need of the development of a standardized procedure and terminology for the use of medical examiners in making such mass studies of normal children was very apparent from the analysis of our material. The problem of determining the abnormalities and the degree of each abnormality which constitutes a real handicap to the child is one which, if it is capable of solution, must be met by the medical profession. The layman can readily judge the significance of seriously defective vision or hearing in the school progress of a child but must depend upon an expert's examination to determine at what point the defect ceases to be serious enough to influence his immediate response to a demand upon these senses. Nor can the layman know what physical characters must be examined to discover significant defects. There must be a common decision upon these questions adopted and used by medical examiners for all such studies before there can be any reliable comparison made between the findings of different examiners and before any satisfactory judgment can be reached as to the relationship between physical condition and mental ability.

Many of the generalizations in this field which have been made up to the present time are subject to question because the unstandardized observations upon which they are based do not justify statistical treatment or warrant conclusions in quantitative terms. The whole question of the influence of physical condition and development upon mental ability is so dependent upon the accumulation of trustworthy and comparable data, that it is to be hoped that the problem of accomplishing the necessary standardization of medical observations will be recognized and handled in the future.

NORMS FOR PHYSICAL MEASURES

TABLE 47.—WEIGHT

(*Kilograms*)

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	26.30±.41	27.88±.35	30.82±.48	34.34±.48	38.03±.57
S. D....	4.30±.29	3.68±.25	4.97±.34	4.57±.34	6.04±.40

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	25.09±.25	28.06±.43	31.70±.50	36.98±.84	41.47±.64
S. D....	2.62±.18	4.50±.31	5.16±.35	8.53±.59	6.70±.46

Weight was recorded in pounds to the nearest quarter and changed into the metric system for statistical use. The weight of the loose robe which replaced the child's clothing was deducted to obtain the corrected reading which was recorded.

TABLE 48.—HEIGHT

(*Centimeters*)

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	127.41±.65	130.31±.66	136.29±.78	140.86±.72	146.64±.73
S. D....	6.80±.46	6.92±.46	8.08±.55	6.82±.50	7.70±.52

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	125.28±.70	130.97±.63	135.64±.79	143.96±.92	148.81±.82
S. D....	7.33±.50	6.53±.44	8.20±.56	9.60±.65	8.56±.58

Height was measured in feet and inches to the nearest quarter and changed into the metric system. The child stood with heels together and touching the rod at the base, and with back flattened against the measuring rod. He was asked to "stand tall." Care was taken to see that he did not stretch unduly nor throw his chest out, thus curving his back and shortening his stature.

TABLE 49.—WEIGHT-HEIGHT INDEX

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	20.56±.20	21.34±.24	22.47±.20	24.31±.34	25.84±.31
S. D....	2.08±.14	2.53±.17	2.06±.14	3.21±.24	3.26±.22

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	20.02±.18	21.39±.31	23.30±.35	25.73±.50	27.81±.37
S. D....	1.92±.13	3.21±.22	3.60±.25	5.08±.36	3.88±.26

Baldwin, Bird, T.: Physical Growth and School Progress, page 60:

"One of the most useful and practical indices of growth is the weight-height coefficient which expresses the comparative solidity or robustness of an individual and, therefore, other things being equal, his general nutrition. . . . The weight-height index is obtained by dividing the weight (in kilograms) by the height (in centimeters); this gives the fraction of a kilogram which the individual possesses n weight for each centimeter of height."

TABLE 50.—HEAD MEASUREMENTS

GIRTH OF HEAD

(*Centimeters*)

BOYS

Age.....	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean.....	52.09±.12	52.33±.11	52.25±.10	52.90±.11
S. D.....	1.24±.08	1.17±.08	1.08±.07	1.19±.08

GIRLS

Age.....	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean.....	50.54±.12	51.53±.08	51.51±.13	51.68±.15
S. D.....	1.27±.08	.85±.06	1.34±.09	1.35±.10

The greatest girth of the head was measured by adjusting the steel tape over the frontal and occipital prominences, taking care to avoid the bunching of the hair under the tape.

TABLE 51.—LENGTH OF HEAD

(*Centimeters*)

	Boys			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	17.82±.05	17.86±.06	17.90±.04	18.04±.03
S. D	.57±.04	.60±.04	.42±.03	.36±.02
	Girls			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	17.10±.05	17.21±.05	17.38±.06	17.53±.06
S. D	.50±.03	.52±.04	.60±.04	.58±.04

TABLE 52.—WIDTH OF HEAD

(*Centimeters*)

	Boys			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	14.95±.02	15.15±.04	14.98±.05	15.23±.06
S. D	.24±.02	.45±.03	.50±.03	.58±.04
	Girls			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	14.55±.04	14.72±.07	14.68±.05	14.84±.06
S. D	.44±.03	.72±.05	.50±.03	.52±.04

The greatest length and width of the head were measured with steel calipers according to instructions given in Whipple's Manual of Mental and Physical Tests, Part I, Chapter 4, pages 78–81.

TABLE 53.—CHEST MEASUREMENTS

GIRTH OF CHEST

(*Centimeters*)

	Boys			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	57.86±.28	60.73±.36	61.13±.53	63.47±.35
S. D	2.98±.20	3.82±.26	5.61±.38	3.66±.25
	Girls			
Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	54.61±.25	57.99±.25	60.08±.41	63.26±.51
S. D	2.62±.18	2.57±.17	4.27±.29	4.72±.36

The measurement of girth of chest was obtained by adjusting the steel tape at the level of the nipples with sufficient tension to adapt it to the body surface

but care was taken that it should not be too tight to allow the fluctuations caused by breathing to be noted. The reading was taken at the mid-point in the distention of the lungs by breathing. Two independent readings were made and checked by a third when it proved necessary. The corrected reading alone was recorded.

TABLE 54.—DEPTH OF CHEST

(*Centimeters*)

BOYS

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	14.56±.08	14.64±.09	15.00±.09	15.31±.12
S. D	.85±.06	1.00±.07	.96±.06	1.21±.08

GIRLS

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	13.71±.08	14.22±.11	14.68±.11	15.30±.14
S. D	.89±.06	1.15±.08	1.17±.08	1.31±.10

TABLE 55.—BREADTH OF CHEST

(*Centimeters*)

BOYS

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	19.16±.11	19.40±.11	19.98±.11	20.86±.16
S. D	1.11±.07	1.14±.08	1.20±.08	1.65±.11

GIRLS

Age	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9
Mean	17.86±.13	18.51±.10	19.34±.13	20.31±.15
S. D	1.35±.09	1.03±.07	1.33±.09	1.41±.11

In measuring depth and breadth of chest, the calipers were placed at the level of the nipples and at right angles to the axis of the spine. The prongs were adjusted to the body with a firm but light pressure and the measure taken after a normal respiration. Two or three readings were made as for chest girth and the corrected reading recorded.

TABLE 56.—NUMBER OF PERMANENT TEETH

BOYS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	12.00±.11	15.56±.36	19.12±.39	24.61±.22	25.58±.18
S. D	1.08±.08	3.81±.26	4.05±.34	2.25±.16	1.94±.13

GIRLS

Age	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean	12.81±.28	20.11±.38	22.83±.30	24.94±.27	26.71±.12
S. D	2.87±.20	3.73±.26	3.07±.21	2.86±.19	1.30±.09

The number recorded did not include the permanent teeth which had been pulled before the date of the examination.

TABLE 57.—NUMBER OF CANINES

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	.50±.12	1.50±.12	2.12±.13	3.35±.09	3.72±.06
S. D....	.96±.08	1.24±.08	1.37±.09	.82±.06	.60±.04

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	.70±.04	3.19±.16	3.39±.08	3.81±.05	3.96±.03
S. D....	.46±.03	1.54±.11	.84±.06	.55±.04	.33±.02

TABLE 58.—NUMBER OF BICUSPIDS

BOYS

Age.....	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean.....	3.03±.22	4.04±.21	7.33±.10	7.38±.10
S. D.....	1.93±.15	2.20±.15	1.05±.07	1.01±.07

GIRLS

Age.....	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean.....	4.88±.21	5.94±.18	7.10±.08	7.55±.09
S. D.....	2.02±.15	1.89±.13	.81±.05	.89±.06

TABLE 59.—NUMBER OF MOLARS

BOYS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	3.65±.10	4.32±.07	5.04±.17	6.20±.13	6.62±.14
S. D....	.99±.07	.79±.05	1.80±.12	1.39±.09	1.44±.10

GIRLS

Age.....	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9
Mean...	3.96±.04	4.90±.12	5.67±.14	6.51±.15	7.16±.09
S. D....	.39±.03	1.23±.08	1.47±.10	1.54±.11	.98±.07

TABLE 60.—HORIZONTAL SYSTOLIC BLOOD PRESSURE *

	9.0–9.9		10.0–10.9		11.0–11.9		12.0–12.9		13.0–13.9	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
70– 72– 74.....	..	..	..	..	1	..	..	..	1	..
76– 78– 80.....	..	..	2	..	2	..	..	..	..	..
82– 84– 86.....	2	2	3	..	3	..	6	..	7	..
88– 90– 92.....	10	6	7	1	8	1	9	1	5	..
94– 96– 98.....	5	18	9	2	6	4	12	4	5	1
100–102–104.....	21	10	15	19	13	9	7	7	10	4
106–108–110.....	5	7	6	13	8	9	8	11	9	5
112–114–116.....	5	5	3	7	2	14	5	11	7	12
118–120–122.....	2	1	1	4	4	6	3	6	3	14
124–126–128.....	..	..	1	2	..	3	..	7	2	5
130–132–134.....	..	1	..	1	..	1	..	3	1	3
136–138–140.....	..	..	..	..	..	..	..	..	..	3
142.....	..	..	..	..	..	..	..	..	..	2

Judson, C. F., and Nicholson, P.: "Blood Pressure in Normal Children," American Journal Diseases of Children, October, 1914.

TABLE 61.—HORIZONTAL DIASTOLIC BLOOD PRESSURE

AGE	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9	
	Girls	Girls	Girls	Boys*	Girls
30–32–34.....	1	..	..	..	1
36–38–40.....	..	..	..	..	2
42–44–46.....	..	..	1	..	1
48–50–52.....	1	..	1	..	3
54–56–58.....	7	4	1	1	2
60–62–64.....	12	15	10	..	8
66–68–70.....	18	22	20	7	13
72–74–76.....	7	6	10	3	13
78–80–82.....	3	1	4	10	5
84–86–88.....	..	1	2	11	1
90–92–94.....	..	..	1	12	..
96–98–100.....	..	..	..	3	..
102–104–106.....	..	..	..	1	..
108–110–112.....	..	..	..	2	..

* The individual interest of the examiners determined the taking of diastolic blood pressure. The results are therefore incomplete, the thirteen year age group being the only one in which the boys are represented.

TABLE 62.—CRAMPTON INDEX FOR BLOOD PRESSURE

Age	9.0–9.9		10.0–10.9		11.0–11.9		12.0–12.9		13.0–13.9	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
0	..	..	..	..	1	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..
10	..	..	..	1	..	..	..	..	..	..
15	..	1	..	..	..	..	..	1	..	..
20	..	1	..	..	..	1	..	..	..	2
25	2	..	..	..	..	..	..	..	..	2
30	..	1	1	1	..	1	..	..	..	..
35	3	..	2	1	..	1	..	..	..	1
40	..	..	2	4	..	1	..	..	1	4
45	1	1	..	1	3	1	..	1	..	1
50	4	..	1	5	4	4	1	3	..	1
55	..	3	1	1	1	2	2	7	2	4
60	8	6	6	5	3	5	4	3	6	3
65	4	4	6	7	2	5	5	8	4	6
70	10	14	13	6	7	5	4	8	12	7
75	3	9	10	6	13	12	11	10	6	5
80	7	3	4	5	8	5	13	5	7	5
85	5	3	1	4	5	3	6	1	7	4
90	1	1	1	..	2	1	3	3	2	2
95	1	..	..	1	..	..	..	..	..	1
100	..	..	..	..	..	1	..	..	2	1
105	..	..	2	1	..	..	1	..	..	..
Mean..	66.0 ±1.4		68.0 ±1.4		71.4 ±1.2		75.1 ±.99		73.4 ±1.1	
	66.7 ±1.4		64.3 ±1.7		66.7 ±1.5		67.2 ±1.2		64.3 ±1.9	
S. D...	14.22± .97		14.66± .98		12.29± .84		10.42±.70		11.54± .78	
	14.7 ±1.0		17.7 ±1.2		15.4 ±1.0		12.73±.85		19.4 ±1.3	

To obtain this index, note the increase or decrease in systolic blood pressure when the child changes from horizontal to vertical position and the increase in heart rate found by subtracting the horizontal from the vertical pulse rate. These values are then combined into the index from the following table: *

* Crampton, C. Ward: The Blood Ptosis Test and Its Use in Experimental Work in Hygiene, Proceedings of the Society for Experimental Biology and Medicine, 1915, XII, pp. 119–122.

TABLE 63.—BLOOD PRESSURE

Heart Rate Increase	Increase					0	Decrease				
	+10	+8	+6	+4	+2		−2	−4	−6	−8	−10
0 to 4	100	95	90	85	80	75	70	65	60	55	50
5 to 8	95	90	85	80	75	70	65	60	55	50	45
9 to 12	90	85	80	75	70	65	60	55	50	45	40
13 to 16	85	80	75	70	65	60	55	50	45	40	35
17 to 20	80	75	70	65	60	55	50	45	40	35	30
21 to 24	75	70	65	60	55	50	45	40	35	30	25
25 to 28	70	65	60	55	50	45	40	35	30	25	20
29 to 32	65	60	55	50	45	40	35	30	25	20	15
33 to 36	60	55	50	45	40	35	30	25	20	15	10
37 to 40	55	50	45	40	35	30	25	20	15	10	5
41 to 44	50	45	40	35	30	25	20	15	10	5	0

NOTE.—In case of increase in pressure higher than +10 add 5 per cent to the +10 column for each 2 millimeters in excess of 10.

APPENDIX

APPENDIX

REFERENCES

No attempt has been made to present a complete bibliography pertinent to this investigation. Bulletin No. IX of the Bureau of Educational Experiments (New York), "Psychological Tests Revised and Classified Bibliography," covers the field of mental testing with references complete to October, 1918. Excellent bibliographies will be found also in William Stearns' "Psychological Methods of Testing Intelligence" and in G. M. Whipple's "Manual of Mental and Physical Tests." The "Bibliography of Experimental Studies in Physical Growth," in Bird T. Baldwin's "Physical Growth and School Progress," gives an exhaustive list of titles on the subject of physical measurements of children.

Crelle's "Rechentafeln," Thorndike's "Mental and Social Measurements," and "Tables for Statisticians and Biometricians," edited by Karl Pearson; together with tables of seven place logarithms, slide rules, and adding and calculating machines have been used as aids incomputation.

FORMULÆ

These formulæ have been used for computation. They may be found in somewhat different form in J. Udney Yule's "An Introduction to the Theory of Statistics," London: Charles Griffin & Co., 1911.

Mean	Probable Error
$M=\frac{1}{n}\Sigma_{(x)}$	$\frac{\sigma}{\sqrt{n}}.6745$
Standard Deviation	
$\sigma=\sqrt{\frac{\Sigma_{(x^2)}}{n}-M^2_x}$	$\frac{\sigma}{\sqrt{2n}}.6745$
Correlation Coefficient	
$r_{xy}=\frac{\frac{\Sigma_{(xy)}}{n}-M_xM_y}{\sigma_x\sigma_y}$	$\frac{1-r^2_{xy}}{\sqrt{n}}.6745$
Partial Correlation Coefficient	
$r_{xy.z}=\frac{r_{xy}-r_{xz}r_{y\cdot z}}{\sqrt{1-r^2_{xz}}\sqrt{1-r^2_{y.z}}}$	$\frac{1-r^2_{xy.z}}{\sqrt{n}}\ 6745$
Regression Equation	
$X=b_{xy}+(M_x-b_{xy}M_y)\ Y=a+b_{xy}Y$	$\frac{\sigma_x\sqrt{1-r^2_{xy}}}{\sigma_y\sqrt{n}}.6745$
$b_{xy}=r_{xy}\frac{\sigma_x}{\sigma_y};\ a=M_x-b_{xy}M_y$	$=\frac{\sigma_{x.y}}{\sigma_y\sqrt{n}}.6745$
Partial Regression Equation	
$X=a+b_{xy.z}Y+b_{xz.y}Z$	
$b_{xy.z}=r_{xy.z}\frac{\sigma_{x.z}}{\sigma_{y.z}};\quad \sigma_{x.z}=\sigma_x\sqrt{1-r^2_{xz}}$	$\frac{\sigma_{x.yz}}{\sigma_{x.z}\sqrt{n}}.6745$
$a=M_x-b_{xy.z}M_y-b_{xz.y}M_z$	

INSTRUCTIONS FOR GIVING AND SCORING YERKES TESTS INCLUDED IN THE MATURITY SCALE*

Resistance of Visual Suggestion

"The materials for this consists of six pairs of lines. In each case the members of a pair are separated by 1 centimeter. The lines are approximately 1 millimeter in width. The measurements for the several pairs are as follows: Pair (*a*), left-hand member 4 centimeters, right-hand member 5 centimeters; pair (*b*), 5 centimeters and 6 centimeters, respectively; pair (*c*), 6 centimeters and 7 centimeters, respectively; pairs (*d*), (*e*), (*f*), 7 centimeters and 7 centimeters. The lines are drawn in black India ink on white cards, with a separate card for each pair.

"As the experimenter presents the lines of pair (*a*) he asks 'Which is the longer of these two lines?' He notes the response, preferably remembering rather than stopping to record it, turns immediately to pair (*b*), and repeats his question. He next presents pair (*c*), again repeating the question in precisely the same way. Without needless delay, he next presents the lines of pair (*d*), *changing the form of question to 'and of these?'* and repeating the same question for each of the remaining pairs. The subject's judgment in the case of each of the six pairs should be recorded.

"If any one of the judgments for the first three pairs of lines, (*a*), (*b*), (*c*), is incorrect, no credit should be given for the test. If, in case of the pairs of lines, (*d*), (*e*), (*f*) the subject replies that the left-hand member of the pair instead of the right-hand member is longer, or if he says that they are equal, 1 point credit is given for each of the three pairs. That is, 1 point credit is given for each resistance of the suggestion, from the first three pairs of lines, that the right-hand member of the pair is the longer."

Test 15.—Comprehension of Questions

"The materials for this test are the following four questions, each of which is indicated by two or three words on the record blank:

"(*a*) If you were going away and missed your train, what would you do?

"(*b*) If someone has been unkind to you and says he is sorry, what would you do?

"(*c*) Why should you judge a person by what he does rather than by what he says?

"(*d*) Why do we more readily forgive an unkind act done in anger than one done without anger?

"The examiner should repeat question (*a*) slowly and distinctly twice, and then encourage the subject, if necessary, to make some reply. The answer should be recorded on the record blank either in full or in substance. The examiner should in like manner present questions (*b*), (*c*), and (*d*).

"Satisfactory replies are as follows: (*a*) 'wait for the next' or 'take an electric car'; (*b*) 'forgive him' or 'pardon him'; (*c*) 'because one is more sure of acts than of words' or 'because one may lie in what he says, but you're sure of what he does'; (*d*) 'an angry person is not responsible or does not realize what he

*A Point Scale for Measuring Mental Ability—Robert M. Yerkes, James W. Bridges, Rose S. Hardwick: Warwick and York, 1915.

does' or 'an act done in anger is not intentional.' For these, or answers expressing like ideas, full credit of 2 points for each question is allowed.

"For less comprehensive and intelligent answers such as (*a*) 'go home,' (*b*) 'be kind to him' or 'do nothing,' (*c*) 'actions speak louder than words,' partial credit of 1 point for each question is allowed."

Test 16.—Drawing Designs from Memory

"The two Binet designs are used for this test. The examiner should say to the subject, 'I am going to show you two drawings. After you have looked at them, I shall take them away and ask you to draw both of them from memory. You must look at them carefully because you will see them for only fifteen seconds, and that is a very short time.' " [A time limit of 10 instead of 15 seconds must be used in giving this test as part of the Maturity Scale since that was the limit used in this investigation. See page 73.

"The examiner then presents the designs in the orientation indicated by the figure, and with either a stop-watch or the second-hand of an ordinary watch, determines properly the interval of exposure. The subject should then be given the opportunity, immediately, to reproduce the designs in pencil on the back of the record sheet

"Credit of 2 points is given for each correct reproduction, even although the lines of the drawings are irregular. For imperfect reproductions, such as those in which the rectangle is placed in the center of the prism section, or the small squares of the other design turned outward instead of inward, 1 point credit is given. No credit is given for anything poorer than the above."

Test 18.—Construction of Sentences

"For this test the three groups of words which follow should be used. The arrangement and spacing is important.

(*a*)	to	asked	paper	my	I	
	teacher	correct	the			
(*b*)	defends	a	his	dog		
	master	good	bravely			
(*c*)	hour	for	we	early	at	
	park	an	started	the		

These three groups are indicated as parts (*a*), (*b*), and (*c*) of the test. Each group should be presented on a separate card.

"The order is important, since (*a*) is much easier than either (*b*) or (*c*), and (*c*) is distinctly more difficult than (*b*).

"The examiner should say to the subject, 'You see these words. Read them to me, please.' And having assured himself that the subject recognizes the words, he should continue, 'Now please arrange them so that they make sense. Make one good sentence out of them, using every word that you read, but no other words.'

"The subject should be allowed only three minutes of actual work on this test. The sentences are to be spoken, not written.

"The most natural form for the sentences follows: (*a*) 'I asked the teacher to correct my paper;' (*b*) 'A good dog defends his master bravely;' (*c*) 'We started for the park at an early hour.'* For each of these sentences, credit of 2 points is allowed; but credit should be allowed also for other sentences, which, although not as natural to the adult as the above, still make perfect sense and are unquestionably, from the childish standpoint, perfectly satisfactory. Such, for example, are: under (*a*), 'I asked my teacher to correct the paper;' under (*b*), 'A master defends his good dog bravely;' under (*c*), 'We started early for an hour at the park' or 'We started for the park at an early hour.' For such sentences full credit should be allowed, and for any others including all of the words so arranged as to make sense and to convince the examiner that the child both understands his task and is able to meet all except the requirements of conventional form and elegance of expression."

Test 19.—Definitions of Abstract Terms

"The three abstract terms (*a*) charity, (*b*) obedience and (*c*) justice are used.

"The examiner should say simply, 'What does charity mean?' and after recording the response, 'What does obedience mean?' and so on.

"The definition of charity should express two ideas, that of unfortunates and of kindness shown to them. If the subject replies 'love,' ask him 'what sort of love?' or 'to whom is the love shown?' The definition of obedience should be 'to do what you are told,' or something similar. If the subject says 'to obey,' ask him what obey means. The definition of justice should express the idea of persons being treated according to their merits, of fairness, or of protection accorded to people, and their interests. If the subject replies 'justice of the peace' or names an individual, he should be told that that is not the kind of justice meant and should be given another trial.

"For an acceptable response, as above defined, credit of 2 points is given in the case of each of the three terms; no partial credits are allowed."

*See p. 73 for variation from this procedure used in this investigation.

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